BUREAU OF FISHERIES

REPORT OF

THE COMMISSIONER OF FISHERIES FOR THE FISCAL YEAR 1912

AND

SPECIAL PAPERS

GEORGE M. BOWERS
Commissioner

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REPORT OF THE COMMISSIONER OF FISHERIES FOR THE FISCAL YEAR ENDED JUNE 30, 1912

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REPORT

OF THE

COMMISSIONER OF FISHERIES.

Department of Commerce and Labor,
Bureau of Fisheries,
Washington, December 2, 1912.

Sir: I have the honor to submit herewith a report giving an outline review of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1912.

COMMERCIAL FISHERIES.

GENERAL CONDITION OF THE INDUSTRY.

The commercial fisheries of the United States during the two calendar years involved in the fiscal year covered by this report were in a generally flourishing condition, and the outlook on the whole is favorable. Although no census of the fishing industry of the United States has been taken for some years, it is possible to make a close estimate based on general information and on special statistical canvasses that have been undertaken by the Bureau. During the calendar year 1911 the fisheries of the country, including Alaska but excluding insular possessions, may be regarded as having had the following approximate extent: Persons engaged, 225,000; vessels employed, 7,500, of 217,000 tons; total capital invested, $65,600,000; yield, $76,000,000, this sum representing the first value of the various products. At present the fisheries of the United States are more valuable than those of any other country except possibly Japan.

The great food-producing fisheries of the offshore, coastal, and interior waters show few specially marked recent changes in condition. The tendency in the last few years, whether downward or upward, has for the most part simply been continued. Among the most important fisheries of the Atlantic coast it may be noted that the mackerel fishery not only shows no signs of improvement but has reached a lower ebb than ever before, owing to the scarcity of fish, while the lobster fishery, more valuable in Maine than in all the other States combined, is reported to be undergoing a marked recuperation as a result of protection and artificial propagation. The major fisheries of the Great Lakes continue to suffer from lack of uniform and consistent regulation. Under present conditions artificial propagation is regarded as essential for the perpetuation of the industry.

Among the fisheries whose products are not used for food but for industrial purposes, the most important are the whale, menhaden, and sponge. The first of these, carried on from Massachusetts and California ports, has reached such a low ebb that there is little profit in it even under the most favorable conditions, and it is destined to decline still further and eventually die unless, by international agreement, prompt and radical protection is afforded to the various species of whales on the high seas. Meanwhile, there has been an increase in shore whaling in Alaska and elsewhere for whales that formerly were largely neglected.

The menhaden fishery is one of the leading fisheries of the Atlantic coast, giving employment to a large number of men on vessels and on shore. In the last two years the run of menhaden has been very large, the number of vessels employed has greatly increased, and the number of establishments for the manufacture of menhaden oil and fertilizer is said to be greater than ever before. The fishery is carried on from North Carolina to Massachusetts. The chief method of capture is with purse seines, although other forms of apparatus are used, such as drag seines, weirs, and gill nets. Menhaden, like mackerel, are very irregular in their movements, and in consequence the quantity caught varies greatly from year to year. The average yield, however, in recent years does not indicate any decline in the fishery. The steam vessels engaged in the menhaden fishery are equipped with many modern improvements, being fitted with electric and search lights, and it is stated that several are equipped with wireless apparatus, by which means they are able to communicate with one another regarding the abundance or scarcity of fish on certain grounds.

The sponge fishery, confined to the coast of Florida, was during the season of 1911–12 subjected to much interference by inclement and stormy weather, with the result that the crop was smaller and the prices were much higher than normal. As these conditions are likely to recur, the Bureau has proposed legislation which would curtail the close season and permit operations during less inclement months than is now legitimate. This relaxation in the regulations can be made with safety to the fisheries, owing to the discovery of new beds beyond the limits previously exploited.

Among recent noteworthy changes in methods or apparatus that may have a far-reaching effect are the increasing use of gill nets in the shore fisheries of New England, the augmenting of the fleet of trawl-net vessels operating out of Boston, and the wholesale capture of salmon by means of purse seines on the grounds off Cape Flattery.

In considering the general prosperity of the fisheries, cognizance must be taken of the part played by fish culture and acclimatization in maintaining and increasing the supply of valuable food animals in all sections of the country. Not the least important feature of

this work is the annual stocking of many thousands of small ponds' lakes, and streams with food and game fishes intended for home use rather than for sale, and hence not figuring in the statistical returns. Conspicuous examples of acclimatization are the shad and striped bass of the Pacific seaboard, which are increasing in abundance and have already yielded several million dollars as the result of an initial outlay of less than $5,000; and the carp, which has become the most widely distributed, abundant, and valuable fish of the interior waters of the country.

Among the most important needs of the fishing industry are the stoppage of the waste of products considered unmarketable, the thorough utilization of parts rejected in the preparation of products for market, and the creation of a local demand for fish and other animals known to be economically valuable in other sections or other countries. Much progress has already been made in the realization of these needs, and a great impetus will be given to the fishing industry when there is a general recognition of their importance.

THE OYSTER INDUSTRY.

More important than any other branch of the fisheries, the United States oyster industry has special interest because it is as valuable as that of all other countries combined, and because of the great development it is capable of undergoing as a result of the more general practice of oyster culture. The oyster business, which in nearly every State from Massachusetts to Texas is the most extensive branch of the fisheries, has for several years been the subject of the most detailed statistical canvass ever undertaken; and the results so far obtained have been published in a number of special bulletins, leaving only a part of the Middle Atlantic region still to be covered. Particular attention has been given to the progress of oyster culture, on which the future success of the industry depends.

As the oyster fishery of the New England States has been exhibited in detail in the report for the fiscal year 1911, the extent and condition of the business along remaining parts of the east coast will now be considered.

In the South Atlantic States the taking of oysters from public and private grounds in 1910 engaged the attention of over 4,200 persons, who received $436,500 in wages and handled 1,700,000 bushels of oysters with a market value of $364,000, of which 456,000 bushels, worth $171,000, came from private grounds. The industry is less extensive here than in any other coast section, owing to the exhaustion of the natural grounds and the comparatively little attention given to oyster planting, combined with unfavorable physical conditions in many localities. The output is largest in South Carolina but the value of the product is greatest in Georgia, owing to the larger pro-

portion of oysters cultivated and the higher price they bring. Following are detailed statistics of this industry as determined by the original field inquiries of the Bureau relating to the calendar year 1910:

STATISTICS OF THE OYSTER INDUSTRY OF THE SOUTH ATLANTIC STATES, 1910.

NORTH CAROLINA.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing			193		193	
On vessels transporting			18		18	
Inshore or boat fisheries	50		650		700	
Shoresmen			313		313	
Total	50		1,174		1,224	
Wages paid:						
Dredging				$11,339		$11,339
Tonging				28,777		28,777
Transporting				1,080		1,080
Wholesale trade				24,006		24,006
Total				65,202		65,202
Vessels, boats, apparatus, and other property:						
Vessels fishing			48	26,888	48	26,888
Net tonnage			410		410	
Vessels transporting			6	3,600	6	3,600
Net tonnage			45		45	
Sail and row boats	50	$1,000	372	16,895	422	17,895
Apparatus—vessel fisheries— Dredges			82	1,427	82	1,427
Apparatus—shore fisheries— Dredges			28	435	28	435
Tongs	50	250	375	1,885	425	2,135
Shore and accessory property				23,500		23,500
Cash capital				23,000		23,000
Total		1,250		97,630		98,880
Planting operations:						
Oyster grounds owned or leased..acres	1,447				1,447	
Oyster grounds under culture..do	(1)				(1)	
Grounds planted during the year, acres	20				20	
Materials planted during the year— Oyster shells..bushels	5,000	150			5,000	150
Expenses connected with planting		(1)				(1)
Oysters on private areas at the end of the year..bushels	(1)	(1)			(1)	(1)
Products:						
Vessel fisheries— With dredges— Market oysters..do			90,783	14,346	90,783	14,346
With tongs— Market oysters..do			75,100	6,008	75,100	6,008
Total			165,883	20,354	165,883	20,354
Shore fisheries— With dredges— Market oysters..bushels			10,539	1,580	10,539	1,580
With tongs— Market oysters..do	17,200	17,200	138,635	24,271	155,835	41,471
Total	17,200	17,200	149,174	25,851	166,374	43,051
Grand total	17,200	17,200	315,057	46,205	332,257	63,405
Wholesale trade:						
Oysters sold opened..gallons					22,032	19,058
Oysters canned..cans					1,056,000	55,900
Oyster shells sold..bushels					157,100	2,763
Total						77,721
Expenses of wholesale trade						19,732

[1] Statistics not available.

STATISTICS OF THE OYSTER INDUSTRY OF THE SOUTH ATLANTIC STATES, 1910—Contd.

SOUTH CAROLINA.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	5		120		125	
Inshore or boat fisheries	3		507		510	
Shoresmen			1,056		1,056	
Total	8		1,683		1,691	
Wages paid:						
Dredging				$700		$700
Tonging		$2,150		79,855		82,005
Wholesale trade				67,403		67,403
Total		2,150		147,958		150,108
Vessels, boats, apparatus, and other property:						
Vessels fishing	3	2,500	50	16,619	53	19,119
Net tonnage	20		540		560	
Gasoline and steam boats	2	1,300	1	650	3	1,950
Sail and row boats	6	60	485	12,110	491	12,170
Apparatus—vessel fisheries—						
Tongs	5	25	122	128	127	153
Apparatus—shore fisheries—						
Dredges			3	35	3	35
Tongs	3	15	496	598	499	613
Shore and accessory property				72,000		72,000
Cash capital				128,500		128,500
Total		3,900		230,640		234,540
Planting operations:						
Oyster grounds owned or leased . acres	340				340	
Oyster grounds under culture . . . do	160				160	
Grounds planted during the year, acres	40				40	
Materials planted during the year—						
Seed oysters . . . bushels	8,000	1,380			8,000	1,380
Oyster shells . . . do			47,582	950	47,582	950
Total		1,380		950		2,330
Expenses connected with planting		(1)				(1)
Oysters on private areas at the end of the year . . . bushels	18,500	2,590			18,500	2,590
Products:						
Vessel fisheries—						
With tongs—						
Market oysters . . . do	4,100	2,860	277,402	32,775	281,502	35,635
Seed oysters . . . do			5,000	750	5,000	750
Total	4,100	2,860	282,402	33,525	286,502	36,385
Shore fisheries—						
With dredges—						
Market oysters . . . bushels			5,000	700	5,000	700
With tongs—						
Market oysters . . . do	1,600	1,600	417,022	55,992	418,622	57,592
Total	1,600	1,600	422,022	56,692	423,622	58,292
Grand total	5,700	4,460	704,424	90,217	710,124	94,677
Wholesale trade:						
Oysters sold opened . . . gallons					1,500	1,312
Oysters canned . . . cans					5,284,866	293,817
Oyster shells sold . . . bushels					660,602	10,850
Total						305,979
Expenses of wholesale trade						103,063

[1] Statistics not available.

STATISTICS OF THE OYSTER INDUSTRY OF THE SOUTH ATLANTIC STATES, 1910—Contd.

GEORGIA.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	109		93		202	
On vessels transporting	5				5	
Inshore or boat fisheries	223		38		261	
Shoresmen			540		540	
Total	337		671		1,008	
Wages paid:						
Dredging		$1,910				$1,910
Tonging		120,915		$17,867		138,782
Transporting		1,175				1,175
Wholesale trade				30,460		30,460
Total		124,000		48,327		172,327
Vessels, boats, apparatus, and other property:						
Vessels fishing	38	25,533	36	20,365	74	45,898
Net tonnage	333		437		770	
Vessels transporting			2	7,235	2	7,235
Net tonnage			41		41	
Gasoline and steam boats	4	1,500	3	1,000	7	2,500
Sail and row boats	208	4,809	41	849	249	5,658
Apparatus—vessel fisheries—						
Dredges	4	80			4	80
Tongs	196	772	122	364	318	1,136
Apparatus—shore fisheries—						
Tongs	394	1,570	14	56	408	1,626
Shore and accessory property				24,550		24,550
Cash capital				74,950		74,950
Total		34,264		129,369		163,633
Planting operations:						
Oyster grounds owned or leased..acres	[1] 5,000				[1] 5,000	
Oyster grounds under culture...do	(2)				(2)	
Grounds planted during the year, acres	(2)				(2)	
Materials planted during the year—						
Seed oysters..bushels	9,500	1,025			9,500	1,025
Oyster shells..do	104,000	2,670			104,000	2,670
Total		3,695				3,695
Expenses connected with planting		4,980				4,980
Oysters on private areas at the end of the year..bushels	(2)	(2)			(2)	(2)
Products:						
Vessel fisheries—						
With dredges—						
Market oysters..do	19,500	9,880			19,500	9,880
With tongs—						
Market oysters..do	214,441	44,823	34,588	11,731	249,029	56,554
Total	233,941	54,703	34,588	11,731	268,529	66,434
Shore fisheries—						
With tongs—						
Market oysters..bushels	199,353	94,935	37,275	9,443	236,628	104,378
Grand total	433,294	149,638	71,863	21,174	505,157	170,812
Wholesale trade:						
Market oysters sold in the shell, bushels					2,500	2,500
Oysters sold opened..gallons					58,850	50,867
Oysters canned..cans					1,422,525	91,402
Oyster shells sold..bushels					34,740	580
Total						145,349
Expenses of wholesale trade						24,374

[1] Estimated. [2] Statistics not available.

STATISTICS OF THE OYSTER INDUSTRY OF THE SOUTH ATLANTIC STATES, 1910—Contd.

FLORIDA (PUBLIC AREAS).[1]

Items.	Number.	Value.
Persons employed:		
On vessels fishing	17	
Inshore or boat fisheries	122	
Shoresmen	179	
Total	318	
Wages paid:		
Tonging		$34,775
Wholesale trade		14,129
Total		48,904
Vessels, boats, apparatus, and other property:		
Vessels fishing	5	2,820
Net tonnage	70	
Gasoline and steam boats	11	4,850
Sail and row boats	115	3,542
Apparatus—vessel fisheries—		
Tongs	17	65
Apparatus—shore fisheries—		
Tongs	46	233
Shore and accessory property		14,600
Cash capital		40,700
Total		66,810

Items.	Number.	Value.
Products:		
Vessel fisheries—		
With tongs—		
Market oysters, bushels	40,000	$4,550
Shore fisheries—		
With tongs—		
Market oysters, bushels	113,460	30,740
Total	153,460	35,290
Wholesale trade:		
Oysters sold opened, gallons	13,920	13,920
Oysters canned....cans	846,348	48,644
Oyster shells sold, bushels	11,644	535
Total		63,099
Expenses of wholesale trade		13,509

GRAND TOTAL.

Items.	Number.	Value.
Persons employed:		
On vessels fishing	537	
On vessels transporting	23	
Inshore or boat fisheries	1,593	
Shoresmen	2,088	
Total	4,241	
Wages paid:		
Dredging		$13,949
Tonging		284,339
Transporting		2,255
Wholesale trade		135,998
Total		436,541
Vessels, boats, apparatus, and other property:		
Vessels fishing	180	94,725
Net tonnage	1,810	
Vessels transporting	8	10,835
Net tonnage	86	
Gasoline and steam boats	21	9,300
Sail and row boats	1,277	39,265
Apparatus—vessel fisheries—		
Dredges	86	1,507
Tongs	462	1,354
Apparatus—shore fisheries—		
Dredges	31	470
Tongs	1,378	4,607
Shore and accessory property		134,650
Cash capital		267,150
Total		563,863

Items.	Number.	Value.
Planting operations:		
Oyster grounds owned or leased....acres	6,787	
Oyster grounds under culture....acres	(2)	
Grounds planted during the year....acres	(2)	
Materials planted during the year—		
Seed oysters, bushels	17,500	$2,405
Oyster shells, bushels	156,582	3,770
Total		6,175
Expenses connected with planting		(2)
Oysters on private areas at the end of the year, bushels	(2)	(2)
Products:		
Vessel fisheries—		
With dredges—		
Market oysters, bushels	110,283	24,226
With tongs—		
Market oysters, bushels	645,631	102,747
Seed oysters, bushels	5,000	750
Total	760,914	127,723

[1] East coast only.

[2] Statistics not available.

STATISTICS OF THE OYSTER INDUSTRY OF THE SOUTH ATLANTIC STATES, 1910.—Contd.

GRAND TOTAL—Continued.

Items.	Number.	Value.	Items.	Number.	Value.
Products—Continued.			Wholesale trade:		
Shore fisheries—			Market oysters sold in the shell..........bushels..	2,500	$2,500
With dredges—			Oysters sold opened, gallons..................	96,302	85,157
Market oysters, bushels..........	15,539	$2,280	Oysters canned.....cans..	8,609,739	489,763
With tongs—			Oyster shells sold, bushels..................	864,086	14,728
Market oysters, bushels.......	924,545	234,181			
Total...........	940,084	236,461	Total...........	....	592,148
Grand total.....	1,700,998	364,184	Expenses of wholesale trade...	....	160,678

NOTE.—In North Carolina the revenue to the State and counties, in taxes and license fees, from the oyster industry in 1910 was $3,122, and the cost of administration was $2,433. In South Carolina the revenue to the State and counties from these sources was $5,332; in Georgia, $1,712; and in Florida, $192.

In the States bordering on the Gulf of Mexico the persons engaged in the oyster industry in 1911 numbered 8,500, and the wages paid amounted to $1,682,000. The output was 6,226,000 bushels, valued at $1,477,000. The development which the oyster industry of the Gulf States has undergone in recent years has depended chiefly on the inauguration and extension of oyster planting in various sections of Louisiana, whose oyster output, in both quantity and value, is now larger than that of all the remaining States of the region. All the States but Louisiana show a diminished product for 1911 as compared with 1908; but with the more general cultivation which is now projected a very marked increase in the oyster crop of the Gulf States will quickly result. Following are detailed statistics of the industry in the calendar year 1911:

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911.

FLORIDA.[1]

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing....................	....	....	21	....	21	....
On vessels transporting................	2	....	....	....	2	....
Inshore or boat fisheries................	66	....	456	....	522	....
Shoresmen....................	....	....	290	....	290	....
Total....................	68	....	767	....	835	....
Wages paid:						
Tonging....................	....	$1,109	....	$98,596	....	$99,705
Transporting....................	....	50	....	....	....	50
Planting and transplanting..............	....	700	....	....	....	700
Wholesale trade....................	....	....	....	31,569	....	31,569
Total....................	....	1,859	....	130,165	....	132,024

[1] West coast only.

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911—Continued.

FLORIDA—Continued.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Vessels, boats, apparatus, and other property:						
Vessels fishing			10	$2,950	10	$2,950
Net tonnage			64		64	
Vessels transporting	1	$1,200			1	1,200
Net tonnage	8				8	
Gasoline boats	9	3,000	46	14,325	55	17,325
Sail and row boats	29	1,905	248	28,365	277	30,270
Apparatus—vessel fisheries—Tongs			21	105	21	105
Apparatus—shore fisheries—Tongs	33	165	455	2,264	488	2,429
Shore and accessory property				31,100		31,100
Cash capital				20,600		20,600
Total		6,270		99,709		105,979
Planting operations:						
Oyster grounds owned or leased . acres	4,149	56,400			4,149	56,400
Oyster grounds under culture . . . do	1,354				1,354	
Grounds planted during the year, acres	78				78	
Materials planted during the year—						
Seed oysters . . . bushels	14,405	1,315			14,405	1,315
Oyster shells . . . do	1,000	47			1,000	47
Broken stone, etc . . . cubic yards	225	225			225	225
Total		1,587				1,587
Expenses of planting and transplanting		25				25
Oysters on private areas at the end of the year . . . bushels	104,105	28,208			104,105	28,208
Products:						
Vessel fisheries—With tongs—Market oysters . . . do			14,944	9,314	14,944	9,314
Shore fisheries—With tongs—						
Market oysters . . . do	12,039	9,969	150,979	89,364	163,018	99,333
Seed oysters . . . do			9,500	825	9,500	825
Total	12,039	9,969	160,479	90,189	172,518	100,158
Grand total	12,039	9,969	175,423	99,503	187,462	109,472
Wholesale trade:						
Market oysters sold in the shell, bushels					18,236	12,301
Oysters sold opened . . . gallons					149,049	135,467
Oysters canned . . . cans					621,072	36,788
Oyster shells sold						137
Total						184,693
Expenses of wholesale trade						25,100

ALABAMA.

Items.	Private areas, Number.	Private areas, Value.	Public areas, Number.	Public areas, Value.	Total, Number.	Total, Value.
Persons employed:						
On vessels fishing	3		78		81	
On vessels transporting	26		57		83	
Inshore or boat fisheries	204		225		429	
Shoresmen			331		331	
Total	233		691		924	
Wages paid:						
Dredging				$5,767		$5,767
Tonging		$12,726		40,913		53,639
Transporting		2,685		11,850		14,535
Planting and transplanting		45				45
Wholesale trade				39,820		39,820
Total		15,456		98,350		113,806

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911—Continued.

ALABAMA—Continued.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Vessels, boats, apparatus, and other property:						
Vessels fishing	1	$400	23	$18,150	24	$18,550
Net tonnage	6		265		271	
Vessels transporting	14	13,500	23	19,750	37	33,2 0
Net tonnage	122		215		337	
Gasoline boats	4	2,300	2	1,300	6	3,600
Sail and row boats	140	3,250	180	11,705	320	14,9 5
Apparatus—vessel fisheries—						
Dredges			12	360	12	360
Tongs	3	15	44	220	47	235
Apparatus—shore fisheries—						
Tongs	128	624	278	1,388	406	2,012
Shore and accessory property		720		166,525		167,245
Cash capital				34,600		34,600
Total		20,809		253,998		274,807
Planting operations:						
Oyster grounds owned or leased..acres	9,273	107,935			9,273	107,935
Oyster grounds under culture...do	3,560				3,560	
Grounds planted during the year, acres	346				346	
Materials planted during the year:						
Seed oysters..............bushels	67,410	3,990			67,410	3,990
Oyster shells..............do	4,525	67			4,525	67
Total		4,057				4,057
Oysters on private areas at the end of the year..............bushels	422,165	86,362			422,165	86,362
Products:						
Vessel fisheries—						
With dredges—						
Market oysters..........do			92,533	13,472	92,533	13,472
With tongs—						
Market oysters..........do	660	440	46,797	7,022	47,457	7,462
Seed oysters..........do			300	15	300	15
Total	660	440	139,630	20,509	[1] 140,290	20,949
Shore fisheries—						
With tongs—						
Market oysters.......bushels	37,311	17,864	194,134	30,044	231,445	47,908
Seed oysters..........do			70,182	3,885	70,182	3,885
Total	37,311	17,864	264,316	33,929	301,627	51,793
Grand total	37,971	18,304	403,946	54,438	441,917	72,742
Wholesale trade:						
Market oysters sold in the shell, bushels					12,669	10,608
Oysters sold opened..........gallons					[2] 261,256	171,001
Oyster shells sold						1,596
Total						183,205
Expenses of wholesale trade						41,843

MISSISSIPPI.

Items.	Private areas, Number.	Private areas, Value.	Public areas, Number.	Public areas, Value.	Total, Number.	Total, Value.
Persons employed:						
On vessels fishing			546		546	
On vessels transporting			12		12	
Inshore or boat fisheries	107		602		709	
Shoresmen			838		838	
Total	107		1,998		2,105	

[1] Includes 65,870 bushels, valued at $9,448, taken by Mississippi vessels.
[2] Includes oysters used for canning purposes with their value when canned.

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911—Continued.

MISSISSIPPI—Continued.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Wages paid:						
Dredging				$87,316		$87,316
Tonging		$2,293		63,302		65,595
Transporting				2,130		2,130
Planting and transplanting		1,040				1,040
Wholesale trade				83,402		83,402
Total		3,333		236,150		239,483
Vessels, boats, apparatus, and other property:						
Vessels fishing			110	156,450	110	156,450
Net tonnage			1,205		1,205	
Vessels transporting			4	13,800	4	13,800
Net tonnage			64		64	
Gasoline boats	1	150			1	150
Sail and row boats	74	910	391	26,850	465	27,760
Apparatus—vessel fisheries—						
Dredges			192	6,200	192	6,200
Tongs			52	197	52	197
Apparatus—shore fisheries—						
Dredges			10	185	10	185
Tongs	74	253	592	2,126	666	2,379
Shore and accessory property		200		349,173		349,373
Cash capital				80,200		80,200
Total		1,513		635,181		636,694
Planting operations:						
Oyster grounds owned or leased...acres	4,798	65,650			4,798	65,650
Oyster grounds under culture...do	2,208				2,208	
Grounds planted during the year, acres	578				578	
Materials planted during the year—						
Seed oysters...bushels	6,675	647			6,675	647
Oyster shells...do	28,480	340			28,480	340
Total		987				987
Expenses of planting and transplanting		50				50
Oysters on private areas at the end of the year...bushels	322,875	100,149			322,875	100,149
Products:						
Vessel fisheries—						
With dredges—						
Market oysters...do			500,700	90,309	500,700	90,309
With tongs—						
Market oysters...do			4,200	560	4,200	560
Total			504,900	90,869	504,900	90,869
Shore fisheries—						
With dredges—						
Market oysters...bushels			4,476	1,111	4,476	1,111
With tongs—						
Market oysters...do	27,350	11,154	114,269	36,639	141,619	47,793
Seed oysters...do			6,675	647	6,675	647
Total	27,350	11,154	125,420	38,397	152,770	49,551
Grand total	27,350	11,154	630,320	129,266	657,670	140,420
Wholesale trade:						
Market oysters sold in the shell, bushels					1,850	1,305
Oysters sold opened...gallons					[1] 132,961	127,735
Oysters canned...cans					3,756,733	251,054
Oyster shells sold						14,698
Total						394,792
Expenses of wholesale trade						114,897

[1] Represents 35,355,350 oysters in number.

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911—Continued.

LOUISIANA.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	20		260		280	
On vessels transporting	141		20		161	
Inshore or boat fisheries	1,440		398		1,838	
Shoresmen	1,388				1,388	
Total	2,989		678		3,667	
Wages paid:						
Dredging		$9,300		$38,510		$47,810
Tonging		141,301		274,579		415,880
Transporting		39,862		4,615		44,477
Planting and transplanting		180,558				180,558
Protecting oysters from natural enemies		5,000				5,000
Wholesale trade		300,475				300,475
Total		676,496		317,704		994,200
Vessels, boats, apparatus, and other property:						
Vessels fishing	3	11,600	42	65,250	45	76,850
Net tonnage	32		529		561	
Vessels transporting	58	82,350	9	34,350	67	116,700
Net tonnage	407		93		500	
Gasoline boats	197	75,260	8	7,250	205	82,510
Sail and row boats	1,400	138,796	158	59,645	1,558	198,441
Apparatus—vessel fisheries—						
Dredges	4	170	66	1,880	70	2,050
Tongs			57	207	57	207
Apparatus—shore fisheries—						
Tongs	1,761	7,679	382	1,756	2,143	9,435
Shore and accessory property		320,430				320,430
Cash capital		328,800				328,800
Total		965,085		170,338		1,135,423
Planting operations:						
Oyster grounds owned or leased..acres	11,582.96	(1)			11,582.96	(1)
Oyster grounds under culture...do	7,767.19				7,767.19	
Grounds planted during the year, acres	3,801.00				3,801.00	
Materials planted during the year:						
Seed oysters..bushels	1,464,525	229,248			1,464,525	229,248
Oyster shells..do	419,975	8,250			419,975	8,250
Total		237,498				237,498
Expenses of planting and transplanting		13,575				13,575
Oysters on private areas at the end of the year..bushels	3,316,630	840,435			3,316,630	840,435
Products:						
Vessel fisheries—						
With dredges—						
Market oysters..do	35,250	15,000	[2] 362,999	78,074	398,249	93,074
Seed oysters..do			15,000	720	15,000	720
With tongs—						
Market oysters..do			[3] 84,479	17,269	84,479	17,269
Total	35,250	15,000	462,478	96,063	497,728	111,063
Shore fisheries—						
With tongs—						
Market oysters..bushels	1,958,830	576,105	[4] 640,113	112,868	2,598,943	688,973
Seed oysters..do			1,407,731	222,687	1,407,731	222,687
Total	1,958,830	576,105	2,047,844	335,555	4,006,674	911,660
Grand total	1,994,080	591,105	2,510,322	431,618	4,504,402	1,022,723

[1] Statistics not available.
[2] Includes 27,450 bushels, valued at $6,855, taken by Mississippi vessels.
[3] Includes 21,779 bushels, valued at $5,465, taken by Mississippi vessels.
[4] Includes 93,614 bushels, valued at $21,618, taken by Mississippi boats.

STATISTICS OF THE OYSTER INDUSTRY OF THE GULF STATES, 1911—Continued.

LOUISIANA—Continued.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Wholesale trade:						
Market oysters sold in the shell, bushels					272,066	$138,630
Oysters sold opened ... gallons					636,959	847,664
Oysters canned ... cans					5,728,181	424,605
Oyster shells sold						36,986
Total						1,447,885
Expenses of wholesale trade						203,147

TEXAS.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	4		118		122	
Inshore or boat fisheries	99		429		528	
Shoresmen	360				360	
Total	463		547		1,010	
Wages paid:						
Tonging		$2,325		$127,994		$130,319
Planting and transplanting		6,518				6,518
Protecting oysters from natural enemies		100				100
Wholesale trade		66,086				66,086
Total		75,029		127,994		203,023
Vessels, boats, apparatus, and other property:						
Vessels fishing	3	1,785	59	36,735	62	38,520
Net tonnage	21		409		430	
Gasoline boats			34	18,650	34	18,650
Sail and row boats	16	1,350	208	42,970	224	44,320
Apparatus—vessel fisheries—Tongs	6	29	118	590	124	619
Apparatus—shore fisheries—Tongs	23	100	388	1,875	411	1,975
Shore and accessory property		77,039				77,039
Cash capital		108,800				108,800
Total		189,103		100,820		289,923
Planting operations:						
Oyster grounds owned or leased ... acres	6,896.04	(1)			6,896.04	(1)
Oyster grounds under culture ... do	571.00				571.00	
Grounds planted during the year, acres	236.00				236.00	
Materials planted during the year—						
Seed oysters ... bushels	69,890	8,044			69,890	8,044
Oyster shells ... do	37,800	924			37,800	924
Total		8,968				8,968
Oysters on private areas at the end of the year ... bushels	199,500	66,295			199,500	66,295
Products:						
Vessel fisheries—With tongs—Market oysters ... do	1,500	500	130,731	43,577	132,231	44,077
Shore fisheries—With tongs—						
Market oysters ... do	7,065	3,115	225,504	76,373	232,569	79,488
Seed oysters ... do			69,890	8,044	69,890	8,044
Total	7,065	3,115	295,394	84,417	302,459	87,532
Grand total	8,565	3,615	426,125	127,994	434,690	131,609
Wholesale trade:						
Market oysters sold in the shell, bushels					14,490	12,777
Oysters sold opened ... gallons					162,492	225,986
Oyster shells sold						4,385
Total						243,148
Expenses of wholesale trade						26,723

[1] Statistics not available.

Statistics of the Oyster Industry of the Gulf States, 1911—Continued.

GRAND TOTAL.

Items.	Number.	Value.
Persons employed:		
On vessels fishing	1,050	
On vessels transporting	258	
Inshore or boat fisheries	4,026	
Shoresmen	3,207	
Total	8,541	
Wages paid:		
Dredging		$140,893
Tonging		765,138
Transporting		61,192
Planting and transplanting		188,861
Protecting oysters from natural enemies		5,100
Wholesale trade		521,352
Total		1,682,536
Vessels, boats, apparatus, and other property:		
Vessels fishing	251	293,320
Net tonnage	2,531	
Vessels transporting	109	164,950
Net tonnage	909	
Gasoline boats	301	122,235
Sail and row boats	2,844	315,746
Apparatus—vessel fisheries—		
Dredges	274	8,610
Tongs	301	1,363
Apparatus—shore fisheries—		
Dredges	10	185
Tongs	4,114	18,230
Shore and accessory property		945,187
Cash capital		573,000
Total		2,442,826
Planting operations:		
Oyster grounds owned or leased ... acres	36,699.00	(1)
Oyster grounds under culture ... acres	15,460.19	
Grounds planted during the year ... acres	5,039.00	
Materials planted during the year—		
Seed oysters, bushels	1,622,905	243,244
Oyster shells, bushels	491,780	9,628

Items.	Number.	Value.
Planting operations—Contd.		
Materials planted during the year—Contd.		
Broken stone, etc., cubic yards	225	$225
Total		253,097
Expenses of planting and transplanting		13,650
Oysters on private areas at the end of the year, bushels	4,365,275	1,121,449
Products:		
Vessel fisheries—		
With dredges—		
Market oysters, bushels	991,482	196,855
Seed oysters, bushels	15,000	720
With tongs—		
Market oysters, bushels	283,311	78,682
Seed oysters, bushels	300	15
Total	1,290,093	276,272
Shore fisheries—		
With dredges—		
Market oysters, bushels	4,476	1,111
With tongs—		
Market oysters, bushels	3,367,594	963,495
Seed oysters, bushels	1,563,978	236,088
Total	4,936,048	1,200,694
Grand total	6,226,141	1,476,966
Wholesale trade:		
Market oysters sold in the shell ... bushels	319,311	175,621
Oysters sold opened, gallons	1,342,717	1,507,853
Oysters canned ... cans	10,105,986	712,447
Oyster shells sold		57,802
Total		2,453,723
Expenses of wholesale trade		411,710

[1] Statistics not available.

Note.—In Florida the revenue from the oyster industry in taxes, license fees, and rentals of oyster grounds in 1911 was $718, and the cost of administration was $175. In Alabama the revenue from these sources was $4,731, and the cost of administration $3,347. In Mississippi the revenue, not including commodity tax, was $12,907. In Louisiana the revenue was $45,503, and in Texas, $6,347.

In the middle Atlantic region, which supports the most extensive oyster industry, the canvass of New York, New Jersey, Pennsylvania, and Delaware has been completed. Of these States, New York has the largest output—over 3,000,000 bushels in 1911—and receives the highest average price per bushel—over 86 cents. New Jersey has the next largest product, 2,778,000 bushels in 1911, and gives employment to the largest number of persons and of vessels. While New York obtains over 86 per cent of market and seed oysters

from private grounds, and owes the importance of the industry to this fact, New Jersey obtains only 35 per cent of the output from private grounds. The oyster interests of Pennsylvania arise from an extensive wholesale trade in Philadelphia, and also from the fact that Philadelphia vessels take oysters in New Jersey and Delaware waters and are properly credited to those States. The feature of Delaware's oyster business is the taking of seed oysters from public grounds and the planting of this seed on private grounds where growth and fattening are completed. Following are detailed statistics for these States for the calendar year indicated:

STATISTICS OF THE OYSTER INDUSTRY OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, 1911.

NEW YORK.

Items.	Private areas.		Public areas.		Total.[1]	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	532		154		686	
On vessels transporting	155		24		179	
Inshore or boat fisheries	743		328		1,071	
Shoresmen	1,043				1,043	
Total[1]	2,473		506		2,979	
Wages paid:						
Dredging		$226,322				$226,322
Tonging		78,630		$396,750		475,380
Transporting		49,032		6,465		55,497
Planting and transplanting		413,037				413,037
Protecting oysters from natural enemies		34,655				34,655
Wholesale trade		405,325				405,325
Total		1,207,001		403,215		1,610,216
Vessels, boats, apparatus, and other property:						
Vessels fishing	129	555,025	75	48,650	204	603,675
Net tonnage	2,210		506		2,716	
Vessels transporting	68	137,400	11	19,000	79	156,400
Net tonnage	1,356		144		1,500	
Gasoline boats	135	67,405	21	6,600	156	74,005
Sail and row boats	441	21,485	230	19,925	671	41,410
Apparatus—vessel fisheries—						
Dredges	361	9,282			361	9,282
Tongs			150	600	150	600
Mops (for starfish)	60	1,205			60	1,205
Apparatus—shore fisheries—						
Dredges	99	1,099			99	1,099
Tongs	1,074	5,952	301	1,901	1,375	7,853
Shore and accessory property		378,673				378,673
Cash capital		930,776				930,776
Total[1]		2,108,302		96,676		2,204,978
Planting operations:						
Oyster grounds owned or leased..acres	87,256.25				87,256.25	
Oyster grounds under culture...do	33,185.27				33,185.27	
Grounds planted during the year, acres	10,783.40				10,783.40	
Materials planted during the year—						
Seed oysters..........bushels	2,895,274	1,577,988			2,895,274	1,577,988
Oyster shells..........do	701,850	38,860			701,850	38,860
Gravel, etc..........cubic yards	3,184	3,551			3,184	3,551
Total		1,620,399				1,620,399

[1] Exclusive of duplication.

STATISTICS OF THE OYSTER INDUSTRY OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, 1911—Continued.

NEW YORK—Continued.

Items.	Private areas.		Public areas.		Total.[1]	
	Number.	Value.	Number.	Value.	Number.	Value.
Planting operations—Continued.						
Expenses connected with planting—						
Planting and transplanting		$52,119				$52,119
Protecting oysters from natural enemies		3,000				3,000
Total		55,119				55,119
Oysters on private areas at the end of the year ... bushels	5,320,365	3,412,521			5,320,365	3,412,521
Products:						
Vessel fisheries—						
With dredges—						
Market oysters ... do	[2]2,509,824	2,215,414			[2]2,509,824	2,215,414
Seed oysters ... do	[3]282,100	138,055			[3]282,100	138,055
With tongs—						
Market oysters ... do			325,000	$265,000	325,000	265,000
Total	2,791,924	2,353,469	325,000	265,000	3,116,924	2,618,469
Shore fisheries—						
With dredges—						
Market oysters ... bushels	119,953	137,578			119,953	137,578
Seed oysters ... do	1,400	700			1,400	700
With tongs—						
Market oysters ... do	460,642	468,376	132,500	113,300	593,142	581,676
Seed oysters ... do			86,400	43,200	86,400	43,200
Total	581,995	606,654	218,900	156,500	800,895	763,154
Grand total	3,373,919	2,960,123	543,900	421,500	3,917,819	3,381,623
Wholesale trade:						
Market oysters sold in the shell, bushels					1,392,651	1,839,006
Oysters sold opened ... gallons					883,161	1,186,095
Oyster shells sold ... bushels					293,627	9,966
Total						3,035,067
Expenses of wholesale trade						188,314

NEW JERSEY.

Items.	Private areas, Number.	Private areas, Value.	Public areas, Number.	Public areas, Value.	Total, Number.	Total, Value.
Persons employed:						
On vessels fishing	847		1,785		1,955	
On vessels transporting	85		11		96	
Inshore or boat fisheries	1,426		919		2,048	
Shoresmen	247				247	
Total[1]	2,513		2,709		4,187	
Wages paid:						
Dredging		$86,228		$144,845		$231,073
Tonging		40,175		146,090		186,265
Transporting		7,640		1,275		8,915
Planting and transplanting		35,440				35,440
Wholesale trade		64,440				64,440
Total		233,923		292,210		526,133
Vessels, boats, apparatus, and other property:						
Vessels fishing	200	362,500	291	410,425	304	427,370
Net tonnage	2,776		3,631		3,875	
Vessels transporting	51	64,460	6	7,200	57	71,660
Net tonnage	542		43		585	

[1] Exclusive of duplication.
[2] Includes 318,227 bushels, valued at $274,543, taken by Connecticut vessels.
[3] Includes 235,500 bushels, valued at $112,250, taken by Connecticut vessels.

STATISTICS OF THE OYSTER INDUSTRY OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, 1911—Continued.

NEW JERSEY—Continued.

Items.	Private areas.		Public areas.		Total.[1]	
	Number.	Value.	Number.	Value.	Number.	Value.
Vessels, boats, apparatus, and other property—Continued.						
Gasoline boats	286	$74,820	170	$35,260	332	$84,295
Sail and row boats	880	43,695	603	44,961	1,367	79,016
Apparatus—vessel fisheries—						
Dredges	394	7,770	576	11,585	596	12,015
Tongs	2	9	106	553	106	553
Apparatus—shore fisheries—						
Dredges	68	564	46	750	112	1,264
Tongs	986	4,881	1,012	5,278	1,790	9,144
Shore and accessory property		244,945		200		245,145
Cash capital		123,300				123,300
Total[1]		889,324		516,212		1,027,262
Planting operations:						
Oyster grounds owned or leased . acres	34,699.68	263,245			34,699.68	263,245
Oyster grounds under culture . . . do	24,986.39				24,986.39	
Grounds planted during the year, acres	4,057.73				4,057.73	
Materials planted during the year—						
Seed oysters . . . bushels	1,545,861	410,407			1,545,861	410,407
Oyster shells . . . do	196,050	16,172			196,050	16,172
Total		426,579				426,579
Expenses connected with planting—						
Planting and transplanting		56,975				56,975
Oysters on private areas at the end of the year . . . bushels	5,342,965	1,897,762			5,342,965	1,897,762
Products:						
Vessel fisheries—						
With dredges—						
Market oysters . . . do	564,513	428,885	5,450	4,140	569,963	433,025
Seed oysters . . . do	10,300	2,940	1,442,520	287,266	1,452,820	290,206
With tongs—						
Market oysters . . . do	675	400	100	100	775	500
Seed oysters . . . do			3,200	735	3,200	735
Total	575,488	432,225	1,451,270	292,241	2,026,758	724,466
Shore fisheries—						
With dredges—						
Market oysters . . . bushels	52,279	41,720			52,279	41,720
Seed oysters . . . do			23,000	5,350	23,000	5,350
With tongs—						
Market oysters . . . do	326,453	320,157	18,300	14,152	344,753	334,309
Seed oysters . . . do	19,315	7,442	312,105	131,328	331,420	138,770
Total	398,047	369,319	353,405	150,830	751,452	520,149
Grand total	973,535	801,544	1,804,675	443,071	2,778,210	1,244,615
Wholesale trade:						
Market oysters sold in the shell, bushels					[2] 899,342	931,419
Oyster shells sold . . . bushels					27,000	1,200
Total						932,619
Expenses of wholesale trade						43,421

[1] Exclusive of duplication.
[2] Includes oysters opened by one firm with their value as sold by the gallon.

STATISTICS OF THE OYSTER INDUSTRY OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, 1911—Continued.

PENNSYLVANIA.[1]

Items.	Number.	Value.	Items.	Number.	Value.
Persons employed:			Wholesale trade:		
Shoresmen	211		Market oysters sold in the shell.......bushels	923,300	$1,002,379
Wages paid:			Oysters sold opened, gallons	79,481	114,720
Wholesale trade		$79,772	Total		1,117,099
Vessels, boats, apparatus, and other property:			Expenses of wholesale trade		65,776
Shore and accessory property		400,100			
Cash capital		147,500			
Total[2]		547,600			

DELAWARE.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Persons employed:						
On vessels fishing	333		209		366	
Inshore or boat fisheries	66		198		243	
Shoresmen	3				3	
Total[2]	382		407		592	
Wages paid:						
Dredging		$24,664		$14,570		$39,234
Tonging				15,682		15,682
Transporting		300		50		350
Planting and transplanting		9,840				9,840
Wholesale trade		600				600
Total		35,404		30,302		65,706
Vessels, boats, apparatus, and other property:						
Vessels fishing	55	122,780	41	60,545	58	124,865
Net tonnage	750		475		776	
Gasoline boats	2	550	20	5,235	21	5,485
Sail and row boats	13	185	169	1,950	182	2,135
Apparatus—vessel fisheries—Dredges	92	1,895	82	1,665	98	1,965
Apparatus—shore fisheries—Tongs			196	830	196	830
Shore and accessory property		5,675				5,675
Cash capital		2,500				2,500
Total[2]		133,585		70,225		143,455
Planting operations:						
Oyster grounds owned or leased.acres	7,178	23,150			7,178	23,150
Oyster grounds under culture...do	5,465				5,465	
Grounds planted during the year, acres	812				812	
Materials planted during the year—						
Seed oysters.......bushels	496,425	88,235			496,425	88,235
Oyster shells.......do	109,550	4,552			109,550	4,552
Total		92,787				92,787
Expenses connected with planting—Planting and transplanting		10,315				10,315
Oysters on private areas at the end of the year.......bushels	1,527,300	528,260			1,527,300	528,260

[1] The oysters taken by Pennsylvania vessels are included in New Jersey and Delaware, as the grounds from which they were obtained are in those States. The quantity taken by Pennsylvania vessels from grounds in New Jersey in 1911 was 18,000 bushels, valued at $10,000, and from grounds in Delaware 87,554 bushels, valued at $46,225.

[2] Exclusive of duplication.

STATISTICS OF THE OYSTER INDUSTRY OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, 1911—Continued.

DELAWARE—Continued.

Items.	Private areas.		Public areas.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Products:						
Vessel fisheries—						
With dredges—						
Market oysters ......bushels..	205,546	$164,558	....	....	205,546	$164,558
Seed oysters............do....	....	....	229,525	$42,979	229,525	42,979
Total........................	205,546	164,558	229,525	42,979	435,071	207,537
Shore fisheries—						
With tongs—						
Market oysters.......bushels..	....	....	49,162	14,302	49,162	14,302
Seed oysters............do....	....	....	9,295	1,380	9,295	1,380
Total........................	....	....	58,457	15,682	58,457	15,682
Grand total................	205,546	164,558	287,982	58,661	493,528	223,219
Wholesale trade:						
Market oysters sold in the shell, bushels..............................	....	....	....	....	3,100	3,100
Expenses of wholesale trade................	....	....	....	....	....	190

NOTE.—In New York the revenue to the State and towns from sales and leases of oyster grounds and other sources in 1911 was $30,656. In New Jersey the revenue to the State was $29,412, and the cost of administration $28,744. In Delaware the revenue to the State was $6,104.

From the information now in hand, it is possible to present the following approximate summary of the United States oyster crop, the figures being partly estimated for several States in which the canvass has not yet been completed. It appears that an output of over 37,000,000 bushels was valued at nearly $17,000,000, and that while only a little more than half the product marketed came from private grounds, this represented more than two-thirds of the total values.

APPROXIMATE OYSTER PRODUCT OF THE UNITED STATES.

Regions.	Private grounds.		Public grounds.		Total.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
New England States (1910).......	5,549,318	$3,439,450	392,703	$157,584	5,827,821	$3,589,719
Middle Atlantic States (1911)....	10,803,000	6,991,225	12,386,557	3,858,232	23,189,557	10,849.457
South Atlantic States (1910).....	456,194	171,298	1,244,904	192,886	1,700,998	364,184
Gulf States (1911)................	2,080,005	634,147	4,146,136	842,819	6,226,141	1,476,966
Pacific States (1908)..............	308,843	692,700	600	1,000	309,443	693,700
Total..........................	19,197,360	11,928,820	18,170,800	5,052,521	37,253,960	16,974,026

NEW ENGLAND VESSEL FISHERIES.

The important vessel fisheries centering at Boston and Gloucester afford a criterion of the condition of the New England fisheries as a whole, and also indicate the relative abundance of the principal food fishes on the various grounds lying off the coasts of the United States, Canada, and Newfoundland. These fisheries have received special attention from the Bureau for many years, and detailed statistics therefor have been collected and published in the form of monthly and yearly bulletins, showing by fishing grounds the quantity and value of fish landed at each of the two ports named.

During the calendar year 1911 American fishing vessels landed at Boston 3,971 fares or trips, comprising 93,760,109 pounds of fish, valued at $2,575,282, and at Gloucester 2,829 fares, aggregating 91,393,258 pounds, valued at $2,449,215, a total of 6,800 fares, 185,153,367 pounds, and $5,024,497. As compared with 1910 there were 241 more trips landed, and an increase of 3,419,095 pounds of fish, worth $191,156. The cod is the most valuable product of these fisheries, but the haddock, ranking second in value, is taken in somewhat larger quantities. Next in rank among the ground fishes are hake, halibut, pollock, and cusk. Of the surface-swimming fishes, the mackerel and herring are most important. There was a decrease in the yield of cod, hake, pollock, herring, and several other species. Dealers at Gloucester imported from Newfoundland and Nova Scotia during the year 4,239,207 pounds of salted cod, which more than offset the falling off in the quantity of cod caught and landed by the American fishing fleet at that port. Detailed statistics of these fisheries are given by months and fishing grounds in the following tables:

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1911, SHOWN BY MONTHS.

Months.	Number of trips.	Cod.				Cusk.				Haddock.			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.													
January	374	936,900	$34,154			141,700	$3,510			5,343,700	$120,132		
February	303	908,500	34,832			112,300	3,691			5,043,400	148,333		
March	342	2,954,000	81,652			267,300	6,662			6,164,300	157,414		
April	333	2,063,550	54,489			338,000	6,832			3,564,300	76,422		
May	268	2,879,200	71,445			548,200	10,174			2,403,900	67,054		
June	179	1,281,400	41,525			233,200	5,055			1,880,200	37,555		
July	298	1,551,600	50,134			82,100	1,559			3,416,000	50,372		
August	354	2,164,300	80,032			143,400	2,790			5,207,800	85,291		
September	314	1,561,800	64,064			154,200	2,941			4,495,700	76,660		
October	425	1,693,000	70,610			294,100	5,991			4,483,600	119,576		
November	444	1,955,600	80,152			263,000	5,691			2,524,700	95,341		
December	337	1,754,450	51,425			339,300	6,162			3,159,700	92,594		
Total	3,971	21,704,300	714,514			2,916,800	61,058			47,687,300	1,126,744		
LANDED AT GLOUCESTER.													
January	79	85,803	2,405	355,955	$18,435	5,370	99	2,245	$59	787,025	14,909	5,995	$120
February	70	69,957	2,997	128,929	6,913	18,460	487	2,445	68	459,916	13,198	4,235	85
March	173	438,934	12,080	204,529	10,754	23,655	415	2,700	72	687,730	18,427	9,090	182
April	277	860,354	18,783	623,566	28,700	220,571	3,761	3,535	90	1,069,441	18,041	8,642	173
May	365	2,018,265	45,292	856,141	38,108	740,323	13,160	10,802	270	579,079	7,953	19,581	392
June	298	1,109,486	22,683	2,416,452	96,325	387,369	6,780	49,450	1,238	367,922	4,234	51,821	1,015
July	181	1,736,378	37,613	3,456,641	140,192	484,032	7,929	36,425	908	903,053	10,388	50,276	1,005
August	188	1,516,014	32,648	2,035,784	88,129	349,733	5,597	47,765	1,195	1,278,379	13,342	67,617	1,265
September	240	1,998,734	45,527	2,664,926	118,428	691,657	11,759	34,111	855	898,448	10,264	73,362	1,285
October	254	961,438	23,092	2,946,068	144,439	303,288	5,326	36,262	908	418,060	4,967	84,680	1,481
November	359	952,295	23,643	3,192,875	153,414	217,868	3,946	11,845	297	299,752	8,490	74,028	1,295
December	345	525,185	13,211	847,168	42,653	74,376	1,337	10,433	261	275,297	6,915	14,447	252
Total	2,829	12,272,843	279,974	19,729,034	886,490	3,516,702	60,596	248,018	6,221	8,024,102	131,128	463,774	8,550
Grand total	6,800	33,977,143	994,488	19,729,034	886,490	6,433,502	121,654	248,018	6,221	55,711,402	1,257,872	463,774	8,550
Grounds east of 66° west longitude	903	14,440,154	367,229	16,172,353	715,952	3,453,579	62,485	126,371	3,164	6,004,698	127,950	302,811	5,509
Grounds west of 66° west longitude	5,897	19,536,989	627,259	3,556,681	170,538	2,979,923	59,169	121,647	3,057	49,706,704	1,129,922	160,963	3,041
Landed at Boston in 1910	4,548	25,903,060	798,728			2,359,300	42,305			44,791,820	1,158,897		
Landed at Gloucester in 1910	2,011	9,646,022	187,098	25,790,251	931,200	2,144,976	33,575	190,609	4,458	4,435,596	66,241	340,559	4,775

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1911, SHOWN BY MONTHS—Continued.

Months.	Hake.				Pollock.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
January	356,600	$14,145			357,400	$12,674			1,500	$416		
February	222,525	10,781			185,300	7,305			22,650	3,152		
March	545,000	20,157			88,500	3,685			60,100	7,315		
April	627,200	14,568			155,400	4,299			89,650	7,729		
May	1,257,200	19,561			181,300	3,323			110,400	8,255		
June	674,900	12,945			206,000	4,706			186,900	11,305		
July	504,100	8,559			185,200	6,086			81,300	6,671		
August	770,800	16,191			847,840	19,806			21,050	1,995		
September	1,017,400	19,277			837,600	19,236			43,700	4,203		
October	3,095,100	46,515			994,750	19,943			76,800	8,051		
November	1,697,700	32,779			619,700	13,643			32,500	3,521		
December	569,400	11,849			436,850	6,675			22,300	3,198		
Total	11,337,925	227,327			5,095,840	121,381			748,850	65,811		
LANDED AT GLOUCESTER.												
January	10,832	350	1,090	$22	50,475	1,298	30,198	$605	46,273	5,452	389	$31
February	21,370	504	625	12	118,900	3,132	16,874	338	84,274	7,541	541	43
March	12,564	405	833	16	147,745	5,819	17,720	355	163,479	16,635	2,742	220
April	120,015	1,603	2,060	38	462,956	7,651	29,745	595	270,573	24,452	1,129	90
May	1,381,015	16,170	6,715	129	5,267,195	57,133	92,644	1,901	272,533	17,227	18,051	1,354
June	1,083,392	10,869	50,842	889	1,597,518	13,120	295,567	5,237	304,031	18,485	73,011	5,816
July	1,018,744	9,449	48,110	824	64,480	876	87,450	1,531	279,962	21,212	6,203	495
August	740,949	6,949	51,652	770	87,301	786	81,706	1,418	238,249	22,239	6,673	533
September	784,525	8,138	83,986	1,404	132,295	1,645	69,588	1,176	307,614	23,816	172,627	15,060
October	661,300	8,722	42,190	750	144,659	2,387	48,512	850	216,317	21,560	116,027	10,308
November	742,318	11,204	48,090	955	836,396	15,425	59,993	1,057	113,487	13,355	10,246	922
December	182,219	2,755	19,225	358	741,258	10,308	48,949	826	45,136	6,793	3,328	299
Total	6,759,243	77,118	355,418	6,167	9,651,178	119,580	878,946	15,889	2,341,928	198,767	410,967	35,171
Grand total	18,097,168	304,445	355,418	6,167	14,747,018	240,961	878,946	15,889	3,090,778	264,578	410,967	35,171
Grounds east of 66° west longitude	6,106,552	82,474	302,340	5,252	817,783	12,783	275,373	4,842	2,432,247	203,835	408,123	34,939
Grounds west of 66° west longitude	11,990,616	221,971	53,078	915	13,929,235	228,178	603,573	11,047	658,531	60,743	2,844	232
Landed at Boston in 1910	16,399,700	265,407			10,148,400	196,267			630,688	54,953		
Landed at Gloucester in 1910	3,359,146	37,189	188,739	2,952	8,659,569	84,154	815,710	11,357	2,357,230	192,557	1,036,081	88,215

Months.	Mackerel.				Other fish.[1]				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.														
January									7,137,800	$185,031			7,137,800	$185,031
February									6,494,675	208,094			6,494,675	208,094
March									10,079,200	276,885			10,079,200	276,885
April									6,838,100	164,339			6,838,100	164,339
May					20,000	$358			7,400,200	180,170			7,400,200	180,170
June	1,322,590	$52,572	106,000	$7,420	16,400	2,366			5,801,590	168,029	106,000	$7,420	5,907,590	175,449
July	469,604	32,069			1,063,550	62,072			7,353,454	217,522			7,353,454	217,522
August	547,320	34,450	25,200	2,335	318,100	29,432			10,020,610	269,987	25,200	2,335	10,045,810	272,322
September	164,230	12,691			128,575	11,924			8,403,205	210,996			8,403,205	210,996
October	52,100	7,065			2,575	426			10,692,025	278,177			10,692,025	278,177
November	32,850	3,267							7,126,050	234,394			7,126,050	234,394
December									6,282,000	171,903			6,282,000	171,903
Total	2,588,694	142,114	131,200	9,755	1,549,200	106,578			93,628,909	2,565,527	131,200	9,755	93,760,109	2,575,282
LANDED AT GLOUCESTER.														
January					2,727,500	81,825	4,353,636	$83,082	3,713,278	106,338	4,749,508	102,354	8,462,786	208,692
February					1,906,250	57,188	795,400	15,465	2,679,127	85,047	949,049	22,924	3,628,176	107,971
March									1,474,107	53,781	237,614	11,599	1,711,721	65,380
April									3,003,910	74,291	668,677	29,686	3,672,587	103,977
May	7,110	508			312,700	4,397	985,124	17,182	10,578,220	161,840	1,989,058	59,336	12,567,278	221,176
June	117,360	4,525	1,031,800	74,087	1,272,080	12,245	11,200	168	6,239,158	92,941	3,980,143	184,775	10,219,301	277,716
July	104,210	5,987	53,100	4,611	278,000	2,260	800	16	4,868,859	95,714	3,739,005	149,582	8,607,864	245,296
August	51,120	3,117	144,800	14,805	565,094	4,628	400	10	4,826,839	89,306	2,436,397	108,125	7,263,236	197,431
September	65,250	3,526	42,000	3,848	462,356	6,153	40,000	800	5,340,879	110,828	3,180,600	142,856	8,521,479	253,684
October	107,460	7,489	12,800	1,355	69,400	869	2,000	40	2,881,922	74,412	3,288,539	160,131	6,170,461	234,543
November	57,630	4,980	23,400	3,180	1,165	52	2,559,228	44,716	3,220,911	81,095	5,979,705	205,836	9,200,616	286,931
December					565,000	16,950	8,015,732	143,500	2,408,471	58,269	8,959,282	188,149	11,367,753	246,418
Total	510,140	30,132	1,307,900	101,886	8,159,545	186,567	16,763,520	304,979	51,235,681	1,083,862	40,157,577	1,365,353	91,393,258	2,449,215
Grand total	3,098,834	172,246	1,439,100	111,641	9,708,745	293,145	16,763,520	304,979	144,864,590	3,649,389	40,288,777	1,375,108	185,153,367	5,024,497
Grounds east of 66° west longitude	1,076,560	39,343	1,161,200	84,687	5,395,984	165,949	16,751,120	304,785	39,727,557	1,062,048	35,499,691	1,159,130	75,227,248	2,221,178
Grounds west of 66° west longitude	2,022,274	132,903	277,900	26,954	4,312,761	127,196	12,400	194	105,137,033	2,587,341	4,789,086	215,978	109,926,119	2,803,319
Landed at Boston in 1910	486,400	48,737	31,000	2,617	1,339,786	143,610			102,059,154	2,708,904	31,000	2,617	102,090,154	2,711,521
Landed at Gloucester in 1910	96,400	7,907	578,600	51,217	5,284,522	152,985	14,720,108	265,940	35,983,461	761,706	43,660,657	1,360,114	79,644,118	2,121,820

[1] Includes herring from Newfoundland—5,323,750 pounds frozen, $158,463, and 16,749,120 pounds salted, $304,745.

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1911, SHOWN BY FISHING GROUNDS.

Fishing grounds.	Number of trips.	Cod.				Cusk.				Haddock.			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.													
East of 66° west longitude.													
La Have Bank	34	652,500	$19,120			293,000	$5,553			684,200	$13,869		
Western Bank	14	279,500	8,566			37,600	532			86,000	1,775		
Quereau Bank	4	212,000	7,780			2,000	35			10,000	133		
Cape Shore	222	3,723,400	118,823			682,400	14,641			2,773,000	75,777		
Gulf of St. Lawrence	1												
West of 66° west longitude.													
Browns Bank	97	1,198,900	29,910			223,500	5,032			1,662,100	30,820		
Georges Bank	498	5,841,900	177,426			174,000	3,558			15,160,600	331,531		
Cashes Bank	26	195,900	6,436			169,600	3,108			63,500	1,593		
Clark Bank	5	23,500	835			15,000	240			71,000	1,225		
Fippenies Bank	7	33,400	1,100			36,500	610			5,200	147		
Middle Bank	588	1,053,900	45,911			326,200	8,341			3,390,300	115,942		
Jeffreys Ledge	395	641,500	24,806			377,200	7,586			1,713,900	57,145		
South Channel	625	3,499,750	139,689			140,000	2,622			17,519,900	362,248		
Nantucket Shoals	42	567,100	12,952							32,600	849		
Off Highland Light	7	10,800	356							74,000	2,372		
Off Chatham	203	937,300	30,136			52,100	1,256			2,535,300	67,207		
Shore, general	1,203	2,832,950	90,668			387,700	7,944			1,905,700	64,111		
Total	3,971	21,704,300	714,514			2,916,800	61,058			47,687,300	1,126,744		
LANDED AT GLOUCESTER.													
East of 66° west longitude.													
La Have Bank	75	1,044,288	23,478	164,866	$7,385	838,308	14,240	10,900	$272	1,127,990	17,301	8,975	$157
Western Bank	76	2,330,880	51,482	2,184,671	89,507	288,830	4,909	17,395	436	404,772	4,733	43,481	823
Quereau Bank	109	2,903,759	63,896	3,687,029	157,762	142,562	2,352	35,713	891	106,559	1,171	78,391	1,437
Misaine Bank	3	167,546	3,927	23,220	988	4,695	80			2,730	32	1,440	25
Green Bank	12			246,790	11,195	880	21	2,270	58			5,155	92
Grand Bank	30			3,948,953	187,513			1,795	45			69,918	1,233
St. Peters Bank	13	156,940	3,336	1,393,413	56,046	2,465	43	403	10	5,485	63	25,580	493
Burgeo Bank	2			7,555	335			65	2				

Off Newfoundland	93			2,106,240	90,715							4,957	94
Cape North	6	344,355	7,035	239,614	9,074	1,462	25	10,690	268	1,570	19	4,168	84
Cape Shore	158	1,950,439	44,380	466,457	22,326	1,158,201	20,033	45,675	1,145	726,853	11,681	19,200	344
Gulf of St. Lawrence	17	143,430	3,093	1,268,877	61,338	1,176	21	225	6			24,955	137
Greenland	4			3,120	145								
St. Anns Bank	19	524,145	12,137	384,393	19,491			695	17	75,539	1,396	16,401	286
The Gully	4	6,972	176	37,980	1,715			545	14			190	4
Labrador Coast	2			9,175	417								
West of 66° west longitude.													
Browns Bank	54	548,911	12,441	633,037	30,881	431,650	7,715	27,620	696	632,894	11,644	30,135	560
Georges Bank	241	1,120,664	27,231	2,869,215	137,122	293,663	4,961	90,952	2,284	1,682,548	28,691	130,255	2,469
Middle Bank	22												
South Channel	54	347,548	7,373			30,673	510			2,434,995	27,677		
Nantucket Shoals	89	21,245	432	350	18	2,130	37			505	6		
South	3												
Shore, general	1,768	661,721	19,557	54,079	2,517	320,007	5,649	3,075	77	821,662	26,714	573	12
Total	2,829	12,272,843	279,974	19,729,034	886,490	3,516,702	60,596	248,018	6,221	8,024,102	131,128	463,774	8,550
Grand total	6,800	33,977,143	994,488	19,729,034	886,490	6,433,502	121,654	248,018	6,221	55,711,402	1,257,872	463,774	8,550

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1911, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Hake.				Pollock.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
East of 66° west longitude.												
La Have Bank	341,500	$6,899			18,800	$403			50,800	$4,432		
Western Bank	54,000	900			9,200	258			286,400	23,732		
Quereau Bank	65,000	1,275			4,000	120			1,000	100		
Cape Shore	1,389,400	27,098			449,900	8,729			118,450	12,338		
Gulf of St. Lawrence									70,000	3,675		
West of 66° west longitude.												
Browns Bank	335,500	5,901			93,600	2,431			94,400	8,105		
Georges Bank	552,800	16,684			263,200	6,697			81,750	8,423		
Cashes Bank	405,000	7,850			40,600	1,348			5,300	462		
Clark Bank	46,000	643			9,600	254						
Fippenies Bank	125,500	2,660			1,200	21			300	30		
Middle Bank	928,800	28,421			338,600	11,209			2,050	302		
Jeffreys Ledge	1,946,900	36,001			933,040	23,061			2,600	328		
South Channel	3,581,000	57,476			703,750	17,262			31,900	3,294		
Nantucket Shoals					50,000	890						
Off Highland Light	4,000	122			2,500	95						
Off Chatham	288,525	7,072			210,000	5,109			1,900	320		
Shore, general	1,274,000	28,325			1,967,850	43,494			2,000	270		
Total	11,337,925	227,327			5,095,840	121,381			748,850	65,811		
LANDED AT GLOUCESTER.												
East of 66° west longitude.												
La Have Bank	907,565	10,013	26,840	$521	90,764	894	14,055	$231	131,084	9,858	822	$71
Western Bank	625,066	6,442	27,620	493	57,505	536	58,396	1,062	196,207	11,685	16,012	1,285
Quereau Bank	504,991	5,449	144,627	2,501	44,302	402	44,821	783	484,663	43,813	23,513	1,864
Misaine Bank	70,375	748			60	1	260	5			90	7
Green Bank	5,450	68	23,850	374	110	3	320	7	207,664	16,643	5,192	416
Grand Bank	2,202	30	10,812	171			34,282	601	110,004	8,247	21,160	1,807
St. Peters Bank	18,665	198	8,588	155	830	8	27,634	481	53,821	5,337	2,022	161
Burgeo Bank			1,040	18					55,355	3,049	4,356	326

Off Newfoundland			2,760	46			7,750	141			2,630	210
Cape North	36,465	373	5,045	88	3,152	29	2,730	48	1,300	112	1,768	141
Cape Shore	2,044,648	22,401	42,098	724	125,190	1,199	35,718	605	514,398	50,313	2,552	227
Gulf of St. Lawrence	8,085	81	8,915	158			22,583	408	71,085	3,856	56,081	4,465
Greenland											180,016	15,904
St. Anns Bank	14,380	208	145	3	13,910	200	26,559	465	200	20	1,098	98
The Gully	18,760	291			60	1	265	5	79,816	6,625		
Labrador Coast											90,811	7,957
West of 66° west longitude.												
Browns Bank	434,915	5,136	4,415	57	23,920	316	86,270	1,567	26,478	2,566	574	46
Georges Bank	185,790	2,034	40,848	716	49,479	581	257,697	4,736	407,568	36,374	2,010	165
South Channel	73,485	982			33,377	303						
Nantucket Shoals					5,412,512	54,220	229,140	4,179				
Shore, general	1,808,401	22,664	7,815	142	3,796,007	60,887	30,466	565	2,285	269	260	21
Total	6,759,243	77,118	355,418	6,167	9,651,178	119,580	878,946	15,889	2,341,928	198,767	410,967	35,171
Grand total	18,097,168	304,445	355,418	6,167	14,747,018	240,961	878,946	15,889	3,090,778	264,578	410,967	35,171

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE YEAR 1911, SHOWN BY FISHING GROUNDS—Continued.

Fishing grounds.	Mackerel.				Other fish.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.														
East of 66° west longitude.														
La Have Bank					2,200	$250			2,043,000	$50,526			2,043,000	$50,526
Western Bank					2,575	426			755,275	36,189			755,275	36,189
Quereau Bank									294,000	9,443			294,000	9,443
Cape Shore	1,015,000	$37,120	106,000	$7,420	64,400	6,454			10,215,950	300,980	106,000	$7,420	10,321,950	308,400
Gulf of St. Lawrence									70,000	3,675			70,000	3,675
West of 66° west longitude.														
Browns Bank					162,600	7,117			3,770,600	89,316			3,770,600	89,316
Georges Bank					625,400	45,114			22,699,650	589,433			22,699,650	589,433
Cashes Bank									879,900	20,797			879,900	20,797
Clark Bank									165,100	3,197			165,100	3,197
Fippenies Bank									202,100	4,568			202,100	4,568
Middle Bank	559,045	33,875	19,200	1,775	43,000	4,730			6,641,895	248,731	19,200	1,775	6,661,095	250,506
Jeffreys Ledge					12,775	1,843			5,627,915	150,770			5,627,915	150,770
South Channel	45,000	2,250			5,400	630			25,526,700	585,471			25,526,700	585,471
Nantucket Shoals	96,600	4,802			600	102			746,900	19,595			746,900	19,595
Off Highland Light									91,300	2,945			91,300	2,945
Off Chatham	363,934	25,461	6,000	560					4,389,059	136,561	6,000	560	4,395,059	137,121
Shore, general	509,115	38,606			[1] 630,250	39,912			9,509,565	313,330			9,509,565	313,330
Total	2,588,694	142,114	131,200	9,755	1,549,200	106,578			93,628,909	2,565,527	131,200	9,755	93,760,109	2,575,282
LANDED AT GLOUCESTER.														
East of 66° west longitude.														
La Have Bank									4,139,999	75,784	226,458	8,637	4,366,457	84,421
Western Bank									3,903,260	79,787	2,347,575	93,606	6,250,835	173,393
Quereau Bank					1,004	96			4,187,840	117,179	4,014,094	165,238	8,201,934	282,417
Misaine Bank									245,406	4,788	25,010	1,025	270,416	5,813
Green Bank									214,104	16,735	283,577	12,142	497,681	28,877
Grand Bank									112,206	8,277	4,086,920	191,370	4,199,126	199,647
St. Peters Bank									238,206	8,985	1,457,640	57,346	1,695,846	66,331
Burgeo Bank									55,355	3,049	13,016	681	68,371	3,730

Off Newfoundland					[2] 5,323,750	158,463	[2] 16,749,120	$304,745	5,323,750	158,463	18,873,457	395,951	24,197,207	554,414
Cape North									388,304	7,593	264,015	9,703	652,319	17,296
Cape Shore	61,560	2,223	1,055,200	77,267	2,055	260			6,583,314	152,490	1,666,900	102,638	8,250,244	255,128
Gulf of St. Lawrence									233,776	7,051	1,381,636	66,812	1,605,412	73,863
Greenland							[2] 2,000	40			185,136	16,089	185,136	16,089
St. Anns Bank									628,174	13,961	429,291	20,360	1,057,465	34,321
The Gully									105,608	7,093	38,980	1,738	144,588	8,831
Labrador Coast											99,986	8,374	99,986	8,374
West of 66° west longitude.														
Browns Bank									2,098,768	39,818	782,051	33,807	2,880,819	73,625
Georges Bank									3,739,712	99,872	3,390,977	147,492	7,130,689	247,364
Middle Bank	13,500	737	112,800	9,503	[3] 20,370	147			33,870	884	112,800	9,503	146,670	10,387
South Channel									2,920,078	36,845			2,920,078	36,845
Nantucket Shoals	117,000	5,022	17,200	1,478	[4] 5,450	181			5,558,842	59,898	246,690	5,675	5,805,532	65,573
South	7,110	508							7,110	508			7,110	508
Shore, general	310,970	21,642	122,700	13,638	[5] 2,806,916	27,420	[6] 12,400	194	10,527,969	184,802	231,368	17,166	10,759,337	201,968
Total	510,140	30,132	1,307,900	101,886	8,159,545	186,567	16,763,520	304,979	51,235,681	1,083,862	40,157,577	1,365,353	91,393,258	2,449,215
Grand total	3,098,834	172,246	1,439,100	111,641	9,708,745	293,145	16,763,520	304,979	144,864,590	3,649,389	40,288,777	1,375,108	185,153,367	5,024,497

[1] Herring 71,000 pounds, value $868; and swordfish, 559,250 pounds, value $39,044.
[2] Herring.
[3] Menhaden, 20,000 pounds, value $100; and swordfish, 370 pounds, value $47.
[4] Herring, 4,400 pounds, value $44; and swordfish, 1,050 pounds, value $137.
[5] Bluebacks, 1,215,200 pounds, value $9,407; herring, 1,000,300 pounds, value $10,732; menhaden, 326,800 pounds, value $1,457; shad, 197,265 pounds, value, $3,078; swordfish, 19,951 pounds, value $2,604; and whiting or silver hake, 47,400 pounds, value $142.
[6] Herring, 1,200 pounds, value $26; and whiting or silver hake, 11,200 pounds, value $168. All other items under "Other fish" are swordfish.

Classifying the grounds shown in the foregoing tables, it appears that of the fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year, 59.37 per cent of the quantity and 55.79 per cent of the value were from fishing grounds lying directly off the United States; 16.55 per cent of the quantity and 16.97 per cent of the value from grounds off the coast of Newfoundland; 23.91 per cent of the quantity and 26.74 per cent of the value from grounds off the Canadian provinces; and less than 1 per cent of the quantity and value from the coasts of Greenland and Labrador. Newfoundland herring constituted 11.92 per cent of the quantity and 9.21 per cent of the value of the products of the vessel fisheries of these ports. The catch of each important species from each of these fishing regions is given in detail in the following table. It should be understood that with the exception of herring taken on parts of the Newfoundland coast where United States fishermen have rights under treaty, the fish caught off the coasts of the Canadian provinces and Newfoundland were not obtained in territorial waters, but on the high seas and on grounds which are the common property of all nations.

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., IN 1911, FROM GROUNDS OFF THE COASTS OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland.[1]		Canadian Provinces.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Cod:								
Fresh....	19,536,989	$627,259	156,940	$3,336	14,283,214	$363,893	33,977,143	$994,488
Salted....	3,556,681	170,538	7,715,246	346,366	8,457,107	369,586	19,729,034	886,490
Cusk:								
Fresh....	2,979,923	59,169	3,345	64	3,450,234	62,421	6,433.502	121,654
Salted...	121,647	3,057	4,533	115	121,838	3,049	248,018	6,221
Haddock:								
Fresh....	49,706,704	1,129,922	5,485	63	5,999,213	127,887	55,711,402	1,257,872
Salted...	160,963	3,041	105,610	1,912	197,201	3,597	463,774	8,550
Hake:								
Fresh....	11,990,616	221,971	26,317	296	6,080,235	82,178	18,097,168	304,445
Salted...	53,078	915	47,050	764	255,290	4,488	355,418	6,167
Pollock:								
Fresh....	13,929,235	228,178	940	11	816,843	12,772	14,747,018	240,961
Salted....	603,573	11,047	69,986	1,230	205,387	3,612	878,946	15,889
Halibut:								
Fresh....	658,531	60,743	426,844	33,276	2,005,403	170,559	3,090,778	264,578
Salted....	2,844	232	306,187	26,781	101,936	8,158	410,967	35,171
Mackerel:								
Fresh....	2,022,274	132,903	....	....	1,076,560	39,343	3,098,834	172,246
Salted....	277,900	26,954	....	....	1,161,200	84,687	1,439,100	111,641
Herring:								
Fresh....	1,075,700	11,644	5,323,750	158,463	....	....	6,399,450	170,107
Salted....	1,200	26	16,751,120	304,785	....	....	16,752,320	304,811
Swordfish:								
Fresh....	1,430,396	101,368	....	....	72,234	7,486	1,502,630	108,854
Other fish:								
Fresh....	1,806,665	14,184	....	....	....	....	1,806,665	14,184
Salted....	11,200	168	....	....	....	....	11,200	168
Total..	109,926,119	2,803,319	30,943,353	877,462	44,283,895	1,343,716	185,153,367	5,024,497

[1] Includes 3,120 pounds of salted cod, valued at $145; 180,016 pounds of salted halibut, valued at $15,904; and 2,000 pounds of salted herring, valued at $40, from Greenland; and 9,175 pounds of salted cod, valued $417; and 90,811 pounds of salted halibut, valued at $7,957, from the Labrador coast.

The vessel fishery which attracts most attention because of the remarkable decline that it has undergone is the mackerel. The season of 1910 was the poorest in the history of the American fishery. The yield in 1911 was much better, amounting to 43,541 barrels of fresh fish and 6,633 barrels of salted fish for all New England, as against 19,950 barrels fresh and 3,395 barrels salted in the previous year. The quantity landed at Boston and Gloucester was 3,098,834 pounds fresh and 1,439,100 pounds salted, valued at $283,887. In 1912, however, the fishery experienced another decline, and the total catch to July 1 was the smallest on record to that date.

For several years the usual run of mackerel has consisted of large fish, but in 1912 tinkers were taken in very considerable quantities. The fleet of vessels that went south in spring numbered 25 seiners, in addition to many small vessels fitted with gill nets. The early season was very unsuccessful for seiners, and few of them paid expenses; but the netters had a fairly good season owing to the high prices received. The Cape Shore fleet, consisting of about 40 seiners, experienced bad weather, found fish scarce, and had an unsuccessful season.

The winter herring fishery on the coast of Newfoundland is interesting and important because of its international relations and its economic value. In the season of 1911-12, 55 American vessels were engaged in the fishery and nearly all obtained full cargoes, second trips being made by 19 vessels and a third trip by 1 vessel. On January 17, 1912, unusually severe weather came on and 27 vessels were caught in the ice, 17 at Bay of Islands and 10 at Bonne Bay. The revenue cutters *Androscoggin* and *Gresham* were immediately sent to their rescue, but before the arrival of the cutters the wind changed, the ice broke up, and the fishing vessels were able to reach the open waters of the Gulf of St. Lawrence, where the cutters met them. One schooner which returned to Bonne Bay was frozen in again and compelled to remain until May.

No Canadian vessels were on the ground, but frequent shipments of pickeled and fresh frozen herring were made from Bonne Bay and Bay of Islands to Halifax by an agent who was stationed at Birchy Cove. Two Newfoundland vessels were engaged in the fishery and landed their fares at Halifax, Nova Scotia.

Besides the usual number of schooners fitted with pans for artificially freezing herring, one vessel was equipped with a cold-storage plant, by which means several cargoes of herring were frozen and then shipped to Gloucester in other vessels belonging to the same firm. A large steamer was provided with a cold-storage plant of about 1,000,000 pounds' capacity; but, owing to the lateness of the season when the machinery was installed, no business was done. Should large vessels of this class engage in the fishery, it would have a tendency to change the frozen-herring industry, as the native fishermen, instead

of taking an active part in freezing herring, as has always been the custom, would merely supply the vessels with fish from the nets.

At times the weather conditions were very unfavorable for fishing. In January one schooner while on a passage from Bonne Bay to Bay of Islands encountered a heavy gale which drove her among the ice and rocks about 8 miles north of Daniels Harbor, where she became a total loss. Her crew was saved, but suffered greatly from exposure, the weather being extremely cold. The captain and one man were badly frostbitten, but finally recovered. Several of the crew traveled a distance of 120 miles on snowshoes to a point on the railroad, where assistance was rendered by the American consul.

Three of the vessels that were forced out of Bay of Islands on account of the ice proceeded to Port aux Basques, on the south shore, their agents remaining at Birchy Cove for the purpose of superintending the taking of herring through the ice in the Humber. The catch, as in the previous year, was shipped by rail to Port aux Basques and there loaded into the vessels.

The season's yield amounted to 68,666 barrels of salted and 23,117 barrels of frozen herring, having a value of $457,816.

The Atlantic halibut fishery is small compared with that of the Pacific coast, and is much less extensive than formerly. The quantity of fresh and salt halibut landed at Boston and Gloucester in recent years has varied but little, however, seldom exceeding three or three and a half million pounds. Each year the same general area of fishing ground is covered, extending from Georges Bank to Greenland, Davis Strait, and sometimes Iceland. Georges Bank, Western Bank, Quereau, La Have, and Cape Shore grounds furnish the greatest amount of fresh halibut, while the trips of fletched fish come from Davis Strait, Greenland, Iceland, and Baffin Bay.

Bacalieu Bank, sometimes called "The Funks," which extends several hundred miles along the eastern coast of Newfoundland, and was at one time an important halibut ground, was visited by a large fleet for a number of years, and is said to have been overfished. In the last few years the catches on that bank have been comparatively small. On the other hand, other abandoned grounds have been resorted to again and have afforded profitable fishing. Thus, good trips of halibut have recently been taken on Emerald Bank, which had not been visited for many years, and a portion of La Have Bank has also attracted a larger number of vessels than usual.

An interesting feature of the fisheries in 1911 was the appearance on the New England coast of larger numbers of swordfish than were ever seen there before, resulting in a correspondingly large catch. Some vessels took from 150 to 200 fish in trips lasting 10 days, and more than 1,000 fish were landed in Boston in one day. The fishing grounds cover a wide area, extending coastwise from Block Island to the

Strait of Canso and including Nantucket Shoals, South Channel, and Georges Bank. The increased demand for swordfish and the good prices received by the fishermen have caused a large fleet of vessels to engage in this fishery in recent years.

PACIFIC COAST FISHERIES.

The taking of halibut has become the most extensive branch of the vessel fisheries of the Pacific coast, and, next to the salmon industry, is the most valuable fishery of the Pacific States and Alaska. The size of the halibut fleet out of Seattle is steadily increasing; new and larger steamers in addition to sailing and power schooners are being added each year; and in the spring of 1912 two modern-type vessels belonging in Gloucester, Mass., joined the halibut fleet of the Pacific as possible precursors of a considerable transference from the east to the west coast.

The halibut catch in 1911 was over 35,000,000 pounds landed at Puget Sound ports, a much larger quantity than was ever taken in the New England fishery. Owing to the growing demand for halibut, a much larger area than formerly is now fished over and greater efforts are put forth to supply the markets. In 1911 the banks of southeast Alaska were assiduously fished by steamers, while a considerable number of schooners that had heretofore resorted to that region confined their operations chiefly to Flattery Bank, where large catches were made. It is generally reported that the banks of southeast Alaska have been overfished, and the results of overfishing have become evident within a few years; some of the most productive grounds show signs of depletion, and the search for newer grounds is in progress.

The Pacific cod fishery supplies to the markets a considerable quantity of salt fish from grounds in Bering Sea and along the central Alaska coast from the Shumagin Islands to Unimak Pass. The business is in the hands of 9 firms having 20 vessels, 13 of which sail from San Francisco and 7 from Puget Sound ports. The yield in 1911 was about 10,770,000 pounds, valued at $325,000, an increase of nearly 50 per cent over 1910.

This fishery is capable of large expansion. Cod are plentiful on offshore grounds of Alaska from Portlock Bank westward, but up to the present time fishermen have not found it necessary to resort to the more remote grounds. Eventually, with the increasing demand for fresh fish, it is probable that special vessels will be built and a fresh-cod fishery established with headquarters at Seattle.

Within a few years seining for salmon in and off the Strait of Juan de Fuca and on Flattery Bank has developed into a fishery of considerable importance, the fleet now consisting of 150 boats,

employing nearly 900 men. The possibility of employing purse seining for the capture of salmon was first brought to the attention of fishermen and dealers in salmon by the Neah Bay Indians, who for many years had made large catches of salmon on these grounds by trolling. As late as 1895 it was not uncommon to see from 40 to 50 canoes on the ground at one time. A portion of the catch was consumed locally; occasional shipments were made to Seattle and Port Townsend. It is understood that among the first to employ purse seines in the capture of salmon on the banks off Cape Flattery were the Greek and Italian fishermen who had previously operated on grounds around the San Juan Islands, Point Roberts, and in many localities where traps were located, the traps being a sort of guide to the best fishing grounds. Purse seining for salmon now seems to be as well established as most other forms of capture employed on Puget Sound.

Formerly when salmon were reported schooling on the banks off Cape Flattery, cannery men and fishermen became actively engaged in making preparations for the run which might be expected to arrive on the fishing grounds near the canneries in the course of a week or 10 days. In late years, however, it has been the custom for the seining fleet to intercept the school on the banks before it reached the headwaters of Puget Sound. The early run of salmon usually appears on the banks in the latter part of May; the various runs of the different species continue throughout the summer and fall months, thus affording fishermen a greater opportunity for carrying on this method of fishing than ever before.

To what extent, if any, purse seines operated on the banks interfere with the catch by traps and gill nets on Puget Sound is not known, but complaints have been made that this practice is injurious in that it destroys a large number of immature fish which, if permitted to grow, would reach a marketable size in a year or two.

It is understood that a Seattle firm is to erect a salmon cannery at Neah Bay, which is the point nearest to the seining grounds on the American side of the Strait of Juan de Fuca. British Columbia packers are also contemplating building canneries on the south coast of Vancouver Island, as they are anxious to obtain a share of salmon that pass over the banks on their way to Puget Sound waters.

Besides the seining fleet, which makes its headquarters at Neah Bay, there is at times a large number of halibut trawlers on these grounds. This fleet is a considerable distance from points where necessary supplies are to be had, and it is reported that several oil-supply stations, three floating-machine shops, one floating restaurant, and three floating bakeries have been established at Neah Bay. The establishment of a floating cannery is also being discussed.

Although the introduced shad has for many years been sufficiently abundant at various places on the western seaboard to supply a large demand, comparatively little use has been made of it until recently. Now, however, there is a large and increasing sale for fresh shad, and considerable quantities of the fish and the roe are being canned after the method followed with salmon.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

GENERAL REVIEW OF THE OPERATIONS.

During the fiscal year 1912 the fish-cultural work of the Bureau of Fisheries was conducted along the established lines, on the usual extensive scale, and with satisfactory results despite many difficulties and drawbacks. The success of artificial propagation depends largely on the physical and meteorological conditions prevailing in the short spawning seasons of the various species of fishes. High winds, freshets, droughts, abnormal heat or cold may render abortive the most elaborate preparations, and cause variations from year to year in the output of the stations so affected. Thus, owing to extremely low-water stages during the summer of 1911 thousands of salmon were unable to ascend the streams covered by the Bureau's operations in California, violent storms on the Great Lakes in fall curtailed the collection of whitefish eggs, while abnormally cold weather and floating ice in the spring of 1912 made it impossible for the fishermen to operate their nets, resulting in a heavy decrease in the take of pike-perch eggs. The losses in these particular fields, however, were more than offset by increased collections elsewhere, so that the total output exceeded that of any previous year.

The fish-cultural work in 1912 was conducted in 31 States and the Territory of Alaska, at 32 main stations and 92 auxiliaries, including the two new salmon hatcheries on the Quilcene and Duckabush Rivers, in the Puget Sound region of Washington, which were completed and put into operation during the year.

Upward of 40 species of valuable food and game fishes, and the lobster, were propagated. The total output was over 3,687,900,000, consisting of 3,426,000,000 fry; 32,214,000 fingerlings, yearlings, and adults; and 229,600,000 eggs.

Following is a summarized statement of the distributions from the hatcheries:

SUMMARY OF DISTRIBUTION OF FISH AND EGGS, FISCAL YEAR 1912.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfish			208,381	208,381
Carp			424,402	424,402
Buffalofish		775,000	175,229	950,229
Shad	2,623,000	172,975,000		175,598,000
Whitefish	9,562,500	125,615,000		135,177,500
Lake herring		16,070,000		16,070,000
Silver salmon	2,000	12,955,824	39,875	12,997,699
Chinook salmon	28,697,550	31,040,893	1,496,260	61,234,703
Blueback salmon	2,000,000	80,765,573	10,656,700	93,422,273
Humpback salmon		6,716,325	1,679,300	8,395,625
Dog salmon		2,495,000		2,495,000
Steelhead trout	808,000	4,288,415	404,190	5,500,605
Rainbow trout	1,208,179	660,935	2,265,612	4,134,726
Atlantic salmon		1,841,221	22,711	1,863,932
Landlocked salmon	196,000	297,298	79,152	572,450
Black-spotted trout	6,389,631	1,578,000	6,285,820	14,253,451
Loch Leven trout			66,300	66.300
Scotch sea trout			10,572	10,572
Lake trout	3,650,000	21,547,700	1,950,660	27,148,360
Brook trout	613,100	4,873,694	5,316,919	10,803,713
Sunapee trout		249,753		249,753
Grayling	200,000			200,000
Smelt	27,650,000	9,575,000	100,650	37,325,650
Pike			4,420	4,420
Crappie and strawberry bass			117,303	117,303
Rock bass			65,642	65,642
Warmouth bass			2,971	2,971
Small-mouth black bass		454,500	107,099	561,599
Large-mouth black bass		18,100	485,993	504,093
Sunfish (bream)			228,300	228,300
Pike perch	122,500,000	208,950,000		331,450,000
Yellow perch	8,500,000	474,284,595	5,920	482,790,515
Striped bass		5,356,000		5,356,000
White perch	15,000,000	452,900,000	670	467,900,670
White bass			1,500	1,500
Fresh-water drum			11,720	11,720
Cod		237,123,000		237,123,000
Pollock		290,370,000		290,370,000
Haddock		95,153,000		95,153,000
Flatfish		965,449,000		965,449,000
Lobster		201,728,000		201,728,000
Total	229,599,960	3,426,106,826	32,214,271	3,687,921,057

Special efforts were directed, as heretofore, to the cultivation of the salmons of the Pacific coast, the commercial fishes of the Great Lakes region, and the anadromous and marine species of the Atlantic seaboard, though the fishes of the interior, comprising various species of trouts, basses, crappies, and sunfishes, also received much attention.

Among the species propagated in larger numbers than in 1911 were flatfish, cod, pollock, haddock, shad, chinook salmon, silver salmon, humpback salmon, steelhead trout, rainbow trout, Sunapee trout, black-spotted trout, yellow perch, striped bass, white perch, smelt, and lobster. Species which, owing to unfavorable conditions for taking eggs, were produced in smaller numbers than in 1911, were whitefish, blueback salmon, Atlantic salmon, landlocked salmon, brook trout, small-mouth black bass, and pike perch.

Notwithstanding the scope and magnitude of the operations as at present conducted, there is a practically exhaustless field in unoccupied territory were fish culture can be profitably inaugurated on as

wide a scale as available funds will permit. In spite of the healthy growth and expansion of the Bureau's activities, facilities are heavily taxed in attempts to supply the constantly increasing demands from all sections of the country for food and game fishes for public and private waters. Large as are the annual distributions, the output of none of the species exceeds the actual need, and in most instances falls short of requirements. Particularly is this true of such fishes as the black basses, crappies, sunfishes, and catfishes, the demand for which, in the stocking of private and semiprivate waters adapted to pond culture, makes imperative the expansion of this branch of the work to its utmost possibilities. The applications received during the year numbered 9,446, and a very large percentage of them were for fish for stocking artificial or private ponds.

COOPERATION WITH STATE AND FOREIGN FISHERY AUTHORITIES.

In continuation of its cooperative relations with the States in fish-cultural work, the Bureau has made large allotments of eggs and limited numbers of fry, fingerlings, and yearlings to State hatcheries. As shown in the following table, such allotments aggregated over 209,000,000 and went to 24 States:

ALLOTMENTS OF FISH EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1912.[1]

States and species.	Number.
California:	
Chinook salmon	20,525,550
Grayling	50,000
Colorado:	
Brook trout	25,000
Grayling	25,000
Rainbow trout	50,000
Connecticut:	
Brook trout	25,000
Pike perch	2,000,000
White perch	15,000,000
Yellow perch	5,000,000
Idaho:	
Rainbow trout	76,500
Maine:	
Brook trout	100,000
Landlocked salmon	75,000
Michigan:	
Lake trout	3,000,000
Landlocked salmon	25,000
Smelt	20,400,000
Minnesota:	
Chinook salmon	10,000
Lake trout	250,000
Landlocked salmon	10,000
Steelhead trout	100,000
Missouri:	
Brook trout	30,000
Rainbow trout	50,000
Pike perch	15,000,000
Yellow perch	2,500,000
Montana:	
Black-spotted trout	1,443,000
Nevada:	
Black-spotted trout	171,631
Brook trout	50,000
Rainbow trout	14,369
New Hampshire:	
Chinook salmon	25,000
New York:	
Black-spotted trout	40,000
Lake trout	50,000
North Dakota:	
Steelhead trout	200,000
Ohio:	
Pike perch	101,500,000
Oregon:	
Black-spotted trout	652,000
Blueback salmon	2,000,000
Brook trout	50,000
Chinook salmon	8,000,000
Rainbow trout	100,000
Pennsylvania:	
Lake trout	100,000
Utah:	
Lake trout	50,000
Vermont:	
Chinook salmon	100,000
Lake trout	100,000
Landlocked salmon	15,000
Steelhead trout	58,000
Washington:	
Brook trout	50,000
Rainbow trout	100,000
Wisconsin:	
Steelhead trout	100,000
Whitefish	5,000,000
Wyoming:	
Black-spotted trout	2,000,000
Brook trout	150,000
Lake trout	50,000
Rainbow trout	138,500
Steelhead trout	100,000
Total	206,734,550

[1] There were also allotted to Connecticut 600,000 shad fry; to Massachusetts, 10,000 chinook salmon fingerlings, to Nebraska, 3,000 brook trout fingerlings and 3,000 rainbow trout fingerlings; to New Jersey, 2,500,000 pike perch fry; and to Vermont, 300 brook trout fingerlings.

The American rainbow trout was established in Europe many years ago, and for a long time was one of the most successful fishes for pond culture. Owing to continuous inbreeding, however, the species eventually deteriorated to such an extent that its cultivation was no longer profitable. The fishery authorities of various European countries thereupon determined to introduce new stock, and, through the usual diplomatic channels, made requests on the Bureau for small lots of eggs. These shipments, together with two kinds of trout eggs for governmental hatcheries in Japan and a lot of black bass fingerlings for Sweden, are shown in the following table:

Shipments of Fish Eggs to Foreign Countries, Fiscal Year 1912.

Countries and species.	Number.	Countries and species.	Number.
Austria:		Japan—Continued.	
Rainbow trout	100,000	Rainbow trout	90,000
France:		Portugal:	
Rainbow trout	25,000	Rainbow trout	50,000
Germany:		Sweden:	
Rainbow trout	50,000	Black bass	[1] 200
Japan:			
Brook trout	20,000		

[1] Fingerlings.

WEST COAST HATCHERY WORK.

Owing to low water in streams tributary to the Sacramento River, and the consequent scarcity of fish in those streams, the collections of salmon eggs for the California stations were about one-fourth less than those of a year ago. Salmon were in the main river in somewhat larger numbers than last season, but this slight increase is not considered to have any special significance, as the run of salmon in the Sacramento has shown a gradual decline for some years. This general decline is attributed to several causes, chief of which are the large losses of young fish by periodic overflows of the river and by their ascent of the various irrigation ditches in operation. Contributing causes are excessive fishing and the destruction of the fry by the rapidly increasing numbers of trout in the river. The obstacle of low water was also encountered in connection with the rainbow trout work at Hornbrook, Cal., reducing the egg collections at that point below those of the preceding year, and at Derby Dam, on the Truckee River in Nevada, where the propagation of the black-spotted trout was again undertaken by the superintendent of the California stations. Trout appeared in this river in large numbers in the spawning season, but the majority remained in the deep pools in its lower reaches, where they were inaccessible. Seining was resorted to but abandoned, owing to the rough character of the river bottom, which caused the nets to rise and permitted the fish to escape. The few eggs secured were turned over to the State officials and the station was closed.

In the Skagit River and tributaries, in Washington, there was no apparent decrease in the run of the various salmons and the steelhead trout, but low water was effective in excluding many of the fish from the spawning beds, and the total egg collections for the Baker Lake station fell behind those of 1911. This loss was compensated for by the increased output of blueback salmon—the most important of the salmons propagated in this region. The production of chinook, silver, and humpback salmon and steelhead trout at the Birdsview station was greater than last year. At the Quilcene and Duckabush stations, completed early in the fiscal year, limited numbers of steelhead trout, silver, humpback, and dog salmon were produced. It is intended to extend greatly the scope of operations of these stations by the establishment of egg-collecting fields on streams tributary to Puget Sound in contiguous territory.

Operations in Oregon and on the Columbia River were conducted under more favorable conditions and resulted in increased distributions of chinook salmon and steelhead trout. The egg collections of the former species at the Little White Salmon station exceeded those of many years.

In response to local belief that the salmon fisheries can be more effectively maintained by the liberation of fingerlings than by the distribution of fry, approximately 1,500,000 young salmon were held in troughs at Clackamas and auxiliary stations for three months and fed on canned salmon and smelt, funds for the purchase of which were donated by the Columbia River salmon packers. At the Big White salmon station the experiment of purchasing brood chinook salmon from trap-net fishermen and holding them in pens to ripen resulted in largely increased egg collections at reduced expense, and it is believed this plan may be advantageously and economically adopted at other points on the Columbia River.

At Yes Bay, Alaska, the hatchery was filled with blueback salmon eggs of superior quality; and sufficient fish to have produced at least 20,000,000 additional eggs were left in the river, owing to lack of hatching facilities. The capacity of this hatchery will be enlarged another year from 72,000,000 to approximately 87,000,000 eggs by increasing the number of eggs to a basket and by the construction of 160 new hatching troughs, which will permit of the rearing of from 35,000,000 to 40,000,000 fry to the feeding stage. In view of the apparent increase in the salmon runs in southeast Alaska, the possibility of securing eggs in larger numbers, and the desirability of rearing a larger percentage of the fry to the fingerling stage, another hatchery of greater capacity than the present one might advantageously be provided.

The collections of blueback salmon eggs at the Afognak station were about equal to those of the previous year. The output, though

somewhat smaller in number, represents in reality a greater degree of success, inasmuch as 10,500,000 young fish were reared to the fingerling stage before liberating, whereas no work of this character was accomplished in 1911. It is believed the usefulness of the Afognak station may be greatly extended by establishing egg-collecting fields on other streams on Afognak and adjacent islands, and it is proposed to establish two such auxiliaries on Kodiak Island, at Eagle Harbor and Uganak Lake, within the next year.

The usual shad operations conducted by the superintendent of the Clackamas station resulted in the liberation of 2,500,000 fry near the falls in the Willamette River. Shad are said to be increasing in the Columbia River to such an extent that the packers are planning increased facilities for placing them on the market.

CONDITIONS ON THE GREAT LAKES.

The prospects for the whitefish work on Lake Erie early in the season were exceedingly bright. In the latter part of October, when the weather was still too warm to permit of penning them, a sufficient number of partially ripe fish were in evidence to have filled the Put-in Bay, Ohio, station with eggs, but a little later, when the temperature had fallen to a suitable point, heavy offshore winds set in, and with short intermissions prevailed to the end of the spawning season, driving the fish from the reefs into the deeper inaccessible waters and keeping them there until the fishermen's nets had been removed for the winter. The result was the collection of only 82,280,000 eggs, the smallest number since 1893. On the other hand, the catch of whitefish by commercial fishermen in the western end of Lake Erie was the largest in years, the bulk of the catch, however, occurring before the beginning and after the close of the spawning season, when the heavy winds had subsided.

In conjunction with the whitefish work, 18,000,000 eggs of the cisco were obtained on the spawning grounds in the vicinity of Cleveland. This is an especially fruitful field for eggs of the cisco, and were it not for the extremely short spawning season, which seldom exceeds 10 days in Lake Erie, it is believed the collections of eggs of this species would have exceeded 50,000,000.

The cold, backward spring and the presence of large fields of floating ice in Lake Erie made it impossible for the fishermen to set their nets in time for the commencement of the spawning of the pike perch, and before the majority of the nets could be installed the season was nearly over. This condition, coupled with the strong winds prevailing the greater part of the spring, caused the egg collections of pike perch for the Put-in Bay station to fall far below the average of recent years, resulting in a corresponding decrease in the output.

In response to local sentiment, efforts were made at the Put-in Bay station to propagate the sauger, and in connection therewith collections of yellow perch were undertaken, but the same causes operating against the work with the more important fishes were even more effective with these species. Only a few eggs were obtained, and in the case of the sauger they were of such inferior quality that no fry were hatched. As the sauger is favorably regarded by the fishermen of Lake Erie, this work will be attempted another year.

At the Michigan stations the total egg collections were about two-thirds short of an average season, and 80,295,500 eggs, fry, and fingerling fish represented the combined output of the three species handled. In addition to the usual sources in the Detroit River for obtaining whitefish eggs, operations were conducted for the first time at Big Charity Island, in Saginaw Bay, and here, notwithstanding the intense severity of the weather encountered, nearly half the season's crop of eggs was secured. Under normal conditions it is believed this new field will prove an exceedingly prolific one.

The lake-trout work, prosecuted at points heretofore operated in Lakes Huron and Michigan, was so hampered by almost continuous storms that the hauling of the fishermen's nets could be accomplished only at intervals of from four to six days, which resulted in the loss of a large percentage of the spawners confined in the nets and lessened the vitality of the eggs obtained. The low market price prevailing during the spawning season for lake trout (3½ cents per pound) contributed to the discouraging results, many of the fishermen finding it to their advantage to discontinue the trout work and devote their time to the capture of herring. Nearly half the 45,225,000 eggs collected were obtained in the vicinity of Manistique and St. James, Mich.

Arrangements were made for the prosecution of the pike-perch work on the customary scale at the points heretofore operated from the Detroit station, but the season was a practical failure owing to the presence of ice on the spawning grounds in the two principal fields in Lake Huron and Saginaw Bay. At the station on the Canadian side of the St. Clair River the spawning season occurs about a month later than in the fields named, and here the usual quota of eggs was secured. The collections at all points aggregated only 21,600,000 eggs, which produced 11,000,000 fry.

The lake trout season at the Duluth station proved an average one. Between September 23 and December 6, 13,000,000 eggs of fair quality were obtained from the various fields in the Lake Superior region. They were hatched in conjunction with 2,500,000 lake trout eggs and 5,000,000 whitefish eggs transferred to Duluth from the Michigan stations, and the fry were distributed in excellent condition, the

bulk of them being returned to the spawning grounds in Lake Superior.

Incidental to experimental sturgeon work conducted from this station, eggs were taken from pike perch caught in the nets and, in the absence of the usual facilities, were developed on fine wire trays placed in a cove at the mouth of the Rainy River. The losses were greater than they would have been had the customary hatching apparatus been available, and from the 1,900,000 eggs secured only 240,000 strong healthy fry were hatched and liberated.

Encouraged by the comparative abundance of whitefish in the vicinity of the Cape Vincent station, on Lake Ontario, plans were made for extended egg collections, and had it not been for the unfortunate weather conditions a considerable degree of success might have been attained. Under existing circumstances 1,270,000 eggs of good quality were collected, also 335,000 lake trout eggs and 100,000 cisco eggs—the first ever incubated at the station. During the spring 2,800,000 pike perch eggs were secured from the fisheries in the vicinity. The customary transfers of eggs of the lake trout, whitefish, and pike perch were made to Cape Vincent from other stations of the Bureau, and the resulting fry were liberated in the lake in good condition.

NEW ENGLAND STATIONS.

At Swanton, Vt., despite the adverse weather conditions encountered at the height of the pike perch spawning season and the smaller numbers of brood fish available as compared with other years, the results of the work were encouraging. The success is attributable to a change in methods. Instead of relying, as heretofore, upon deliveries of brood fish at the station by commercial fishermen, spawn-takers were sent in boats to the fishing shores to take the eggs as soon as the fish were removed from the nets and to return the immature females and surplus males to the spawning grounds in the vicinity of the station. This eliminated the excessive handling and consequent injury to the brood fish experienced under the old system of assorting and holding in pens to ripen and resulted in a larger take of eggs, and eggs of finer quality, than in any previous year in the history of the station. The collections amounted, in round numbers, to 217,000,000, and the output of fry was 51½ per cent of the number of eggs retained in the hatchery for incubation.

The Atlantic salmon operations at the Craig Brook, Me., station resulted in the production of 1,820,349 young fish, liberated in the Penobscot River and its tributaries. This is a falling off as compared with the output of 1911, but it does not indicate any decrease in the run of Atlantic salmon in the Penobscot River. On the contrary, the statistics published by the Maine commissioner of sea and

shore fisheries show that in 1911 there were caught in the waters of that State where the tide ebbs and flows 147,799 pounds of Atlantic salmon, which is the largest catch of fish of that species in 20 years, the next largest being in 1901 and amounting to 96,891 pounds. The smallest catch was in the year 1898, the total being 33,869 pounds. In May and June of 1912 there were secured from waters in the vicinity 1,133 adult salmon, which is the largest brood stock ever collected for the Craig Brook station.

The year's operations with the marine fishes at the Boothbay Harbor station were highly successful. There was a slight deficiency in the cod work, owing to the nonappearance of the second run of fish along the Maine coast, and the haddock work was interfered with by stormy weather, but these shortages were more than offset by the results attained in the hatching and distribution of lobsters and flatfish. Seed lobsters were comparatively abundant, and through the aid of the boat belonging to the State the year's collections numbered 14,902. Of this number 11,362 were successfully carried through the winter in the pound and yielded 162,237,000 eggs of superior quality. The boat purchased by the Bureau during the year permitted of the extension of the flatfi h work over a wider territory and a consequent increase in the output. The collections of cod and flatfish for the Woods Hole station were far above the average, taxing the facilities to the utmost, notwithstanding the installation of additional hatching apparatus.

At the Gloucester station, on the other hand, the cod work accomplished was a little short of an average season, but the falling off was more than made up by the large numbers of pollock, haddock, and flatfish distributed. Here, too, the hatching equipment proved entirely inadequate for the efficient handling of the enormous numbers of eggs coming in during the height of the season, and though the eggs were generally of superior quality the losses during incubation were in some instances abnormal, owing to the necessity of crowding double and sometimes three times the usual number in the hatching equipment available. The success of the work at both stations, though partly due to favorable weather, may in the main be attributed to closer cooperation between the superintendents than has heretofore existed, and the extension and more equitable division of the field because of such cooperation. The experience of the past season has demonstrated that an addition to the equipment of a well-equipped seagoing vessel, capable of following the fishing fleet to distant points, and of sufficient power and stability to remain at sea through stormy weather, will result in greatly increasing the output of the Woods Hole and Gloucester stations and at the same time eliminate the annual outlay of a large sum for the hire of vessel service, which is never satisfactory.

As a result of the constantly dwindling lobster fisheries on the lower part of the Massachusetts coast, and the inability of the Woods Hole station to secure supplies of seed lobsters, as heretofore, from Connecticut waters, owing to differences existing between the State fishery authorities and the fishermen, the lobster work of this station has so narrowed in scope as to become unprofitable. The seed lobsters collected for the station in 1912 numbered only 330, as compared with 1,194 in 1909, the output of fry in 1912 amounting to only 3,283,000. In view of these facts the efforts in this direction in Massachusetts will hereafter be concentrated at the Gloucester station, where the results are more in proportion to the expense involved.

Investigations were continued by the superintendent of the Woods Hole station, with the view of undertaking the artificial propagation of the menhaden, but without overcoming the difficulty heretofore experienced of securing ripe fish of both sexes at one time. It is doubted if any tangible results in the propagation of this fish can be attained until more definite knowledge is gained as to its life history and spawning habits.

MIDDLE ATLANTIC COASTAL WATERS.

While there was no apparent increase over recent years in the run of shad in the Potomac River, a record was established in the take of shad eggs at the Bryans Point station, the collections amounting to 88,727,000 and the yield of fry to 81,000,000, or 92 per cent of the eggs obtained. The nearest approach to this record occurred in 1903, the egg collections of that year numbering 86,370,000 and the output of fry to 69,772,000. The high degree of success is attributed to the uniformly favorable weather and water temperatures during the spawning season, which permitted of the capture of a larger percentage of fish with uninjured eggs, and also to improved methods of handling. Though the take of eggs of yellow perch at this station was somewhat curtailed by cold weather at the beginning of the season, the output of fry amounted to over 192,000,000. The regular hatching apparatus at the station being insufficient to accommodate all of the eggs, large numbers were placed in cylindrical galvanized wire baskets and suspended by tarred marlin lines from fence wire strung horizontally between light pine poles planted 20 feet apart. The baskets thus attached were lowered to within a foot of the bottom in an 8-foot depth of tidewater, and in this manner the eggs were successfully and economically hatched.

At the station on the Susquehanna River there was no material increase in the output of shad fry. The small take of eggs, although to some extent attributable to high winds and low water temperatures prevailing during the spawning season, was principally due to the causes which have operated detrimentally in past years—inade-

quate State protective laws and lax enforcement of those on the statute books. The superintendent of the station reports that the fishermen on the Susquehanna River operate anchored gill nets, which in many instances are lifted only once a day. Shad caught in these nets are stripped of their eggs by eels, and thus not only made useless for fish culture, but reduced in commercial value. There is a law prohibiting the use of these nets, but it is not enforced. The work at this station with the white perch and yellow perch was successful, the output of these fishes showing a material increase over that of the preceding year.

In Albemarle Sound, where fishing is regulated by well-enforced laws, shad were very abundant during the spawning season, large numbers being captured by both the trap and the gill-net fishermen. For the Edenton station 115,617,000 eggs were secured, and the output was 54 per cent greater than that of 1911. The beneficial effects of the protective legislation referred to are so plainly discernible that, encouraged thereby, the Bureau is planning to extend its shad-propagating work by the establishment of an auxiliary station on the lower sound, in the vicinity of the Scuppernong and Perquimans Rivers.

The output of striped bass fry on the Roanoke River amounted to 5,356,000. Though exceeding the output of any season since the establishment of the station at Weldon, the results of the work are not viewed with satisfaction, considering the fact that a single female striped bass often contains as many as 5,000,000 eggs. The usual impediment of high water at the height of the spawning season was again encountered, but even under the most favorable natural conditions it has so far been impossible to produce striped bass in comparatively large numbers, owing to the difficulty of securing ripe fish of both sexes at one time. It is hardly probable that extensive results can be attained until some method has been devised of holding the fish in pens to ripen.

POND CULTURE.

Under favorable conditions little difficulty is experienced in producing in adequate numbers fishes that can be artificially propagated by the manipulation of their eggs, but the constantly growing demands for the black basses, crappies, sunfishes, and catfishes, which must be allowed to reproduce naturally in ponds, make it imperative that the Bureau endeavor to propagate these various warm-water fishes in larger numbers. Heretofore the output has depended to a large extent upon the collections made from the overflows of the Mississippi and Illinois Rivers. When the water stages are favorable this source furnishes an abundant supply, but there are occasionally long periods of drought and low-water stages in the rivers, necessitating the

abandonment of the work, and thereby making this source of supply very uncertain. Owing to low water in the upper Mississippi River in the summer of 1911, rescue operations in fields within reach of the Manchester and Homer stations were confined to a very small territory. Conditions on the Illinois River were more favorable, and the collections of black bass, crappie, and other fishes, though not as large as those of last year, were very satisfactory. But the present high cost of living, coupled with the expense involved in the transportation of foodstuffs to outlying districts, has forcefully called attention to the value of fish ponds as an economical source of food supply, thus creating a demand which the Bureau has been unable to meet with its present facilities. This increasing demand can only be met through the establishment of additional pond-cultural stations.

In accordance with the custom of recent years, the larger portion of the brook-trout eggs handled at the eastern and central stations of the Bureau were purchased from commercial fish culturists, experience having demonstrated that satisfactory results can be secured by this method, and at less expense than is entailed in making collections from open waters within range of such stations. At stations located in fields where the expense involved in the collection of wild eggs justifies field operations the results have been gratifying. This is true of the stations located in the Rocky Mountains.

The results attending the propagation of the black-spotted trout in the Yellowstone National Park, which is the source of egg supply for the South Dakota, Montana, and Colorado stations, justifies the prosecution of the work on a more extensive scale another year. During the summer of 1911 considerably over 20,000,000 eggs were collected and 14,253,451 fry hatched. This excellent work was accomplished with fish-cultural facilities of the most primitive character, and without sufficient shelter for the employees engaged in the operations. The impossibility of handling the large numbers of eggs with the apparatus available at the field stations in the park necessitated the hurried construction of additional hatching troughs, which were located in the beds of streams and at other points where a water supply by gravity could be secured. Frequent losses of eggs occurred in these unsheltered troughs through the depredations of bears. Operations in this field are not undertaken until late in June, but at the end of the last fiscal year the indications were that the egg collections would exceed those of the previous year.

FISH-CULTURAL NOTES.

Experimental propagation of buffalofish.—This work was continued at the auxiliary stations on the upper Mississippi and Illinois rivers, the observations this year being confined to the small-mouth buffalo.

It has been noted that the buffalofish is very irregular in its movements, apparently spawning without reference to weather conditions or locality, and thereby increasing the difficulties connected with its artificial propagation in considerable numbers. Some difficulty was experienced in hatching the eggs obtained, owing either to improper handling in the jars or to their immaturity. The fry that hatched broke the shell in from 15 to 17 days, in a water temperature varying from 58° to 61° F. There was some variation in the size of the eggs, which ran from 13 to 15 to the linear inch after water hardening and about 21 to the inch when first taken. It was decided that 14 to the inch was a fair average, and, taking this as a basis, 180,000 eggs were figured to the quart.

The fry of the small-mouth buffalo are very active, in contrast to the young of the black and common species, which remain dormant in the jars after hatching.

The nets of the commercial fishermen were the main dependence for eggs, a source which proved unreliable. It was intended to test thoroughly the feasibility of penning fish in natural ponds, but continued high water interfered with this plan and it was necessary to hold them in overflowed grounds along the river. In order to attain success in the buffalo work it is believed the adult fish will have to be under control during the whole of the spawning season, and as it is impracticable to hold them in crates or live cars dependence must be placed on ponds of natural construction, thus restricting the work to permanent stations within easy reach of the rivers from which the fish are obtained.

Sturgeon work in Minnesota.—The sturgeon investigations in progress in the Lake of the Woods at the close of the preceding year, under the general direction of the superintendent of the Duluth station, were continued in 1912. Early in March, in advance of the supposed spawning season, fyke nets were installed in the Rainy River in an attempt to intercept all sturgeon ascending to the spawning grounds above. No ripe fish were taken in these nets, nor from those operated later in the season in the open lake by commercial fishermen. Two adults from the Bureau's nets and several from the pound nets were placed in a pen in the river during May for observation. When examined late in June the specimens were found to contain eggs or milt in various stages of development, but none of them was ripe, and at the end of the year the investigations had revealed no definite knowledge as to the spawning habits of the fish.

Effects of volcanic eruption in Alaska.—By the eruption of Mount Katmai on June 6 the islands of Kodiak and Afognak were covered to a depth of 2 to 12 inches with sand and ashes, and large numbers of salmon which were ascending streams in the vicinity were destroyed. It was estimated that 8,000 dead fish were observed on the shore at

the head of Letnik Lake, on Afognak Island, but it is believed there were many more, as some were doubtless entirely covered with ashes. This eruption subjected the station employees to great hardship, but there were no casualties and the Bureau sustained no property loss. Reports submitted at the close of the fiscal year indicated that salmon were again ascending the streams on Afognak Island, and fish-cultural work, though it may possibly be curtailed to some extent, will be resumed.

Attempted work in Nevada.—Fish-cultural operations on the Truckee River at Derby Dam, Nev., inaugurated by the Bureau in 1909 to demonstrate as to the feasibility of propagating the black-spotted trout of that region, were continued in 1912, with results of a negative character. It has so far been impossible to find a desirable site for an eying station within reasonable distance of the railroad where an adequate flow of spring water can be obtained under gravity pressure. The several locations tried have not proved satisfactory. Even under the adverse conditions encountered in this field it is believed eggs of the black-spotted trout might be obtained in profitable numbers were it not for the restrictions placed upon the Bureau by the Nevada Fish Commission, which limits the Federal operations to the vicinity of Derby Dam. This site is also occupied by the State. The work can not be made a success until the State commission abandons its present narrow and distrustful attitude and permits the Bureau not only to construct racks for intercepting the run of spawning fish, but allows it to extend its operations to such points on the river as may be most advantageous for the collection of eggs. Unless such authority is obtained it will be advisable to discontinue the work.

Whitefish egg resources in Minnesota lakes.—Within the limits of the forest reserve in Lake County, Minn., there are numbers of small lakes said to be stocked with a whitefish closely resembling the whitefish of the Great Lakes, and it is reported that two of these lakes can be reached from the Northern Minnesota Railroad without much expense. It may be well for the Bureau to acquire absolute control of the lakes within this reservation with the view of establishing an additional field station at some accessible point for the collection of whitefish eggs. It would not be necessary to pen large numbers of fish to secure the eggs that can be handled advantageously in the course of a season, and with proper care it may be that the Duluth station can be supplied with whitefish eggs from this source in future. It is believed the disposition of the fish when stripped of their eggs could be arranged for through State officials without difficulty.

BIOLOGICAL INQUIRIES AND EXPERIMENTS.

OYSTER INVESTIGATIONS.

The Bureau has been unable to continue the series of surveys of the oyster beds of the several States, which it has been conducting for a number of years and which have proved of value to the States in the administration and development of their oyster resources, owing to the necessity for extensive repairs to the steamer *Fish Hawk*, the services of which are essential to the work. The large amount of data collected in the preceding year during the survey in Alabama and Mississippi Sound has been collated, and at the end of the fiscal year the charts and report of the investigation were practically completed.

Investigations concerning the breeding and general life history of the oyster drill and other animals destructive to the oyster industry have been continued and have resulted in the accumulation of much information which it is hoped may serve as a basis for experiments respecting practical means for protecting the oyster beds from their inroads, which entail a direct and indirect loss difficult to estimate, but undoubtedly exceeding several hundred thousand dollars annually.

The oyster industry yields about one-third of the total income derived from all of the fisheries of the United States. Upon the other fisheries the Government annually expends upward of $500,000 for purposes of fish culture, the methods of which are not applicable to the oyster on account of its peculiar characteristics and life history. For the oyster fisheries to receive from the Government assistance equivalent, in proportion to their value, to that rendered other fisheries, about $250,000 would be required, but as a matter of fact, owing to lack of personnel for the work, the Bureau's annual expenditure in behalf of the oyster industry is usually not 1 per cent of that amount. The oystermen justly complain that they are not receiving their share of consideration at the hands of the Government. Through their own industry and enterprise, with such assistance as the Bureau's limited resources have permitted it to give, they have increased the product of oysters about 65 per cent during the past 22 years, and the increase has been greatest where the Bureau has done most work and where its recommendations have been given best effect. The oyster is probably unique among food products in that during this period of nearly a quarter of a century there has been practically no increase in its cost, although, owing to the development of oyster culture, there has been an improvement in quality.

The oyster industry is subject to many perils and is susceptible to much improvement in its methods, and the Bureau should be provided with the means to give it the assistance which it requires and which its importance and unique record give it the right to demand.

INVESTIGATIONS OF LAKES AND STREAMS.

During the fiscal year the investigation of Lake Sunapee, N. H., was brought to a close. This was undertaken to determine the effects of the introduction of various species of Salmonidæ not indigenous to the lake, especially in respect to the permanence of the species so introduced. Among those was the chinook salmon of the Pacific coast, small plants of which have been made more or less regularly for a number of years at the earnest solicitation of persons interested in maintaining the supply of fishes in this body of water. The species has become established in the sense of the survival of a number of individuals sufficient to supply a considerable catch by sportsmen, but there is no indication that they have ever spawned or are likely to spawn under the landlocked conditions obtaining. To maintain the supply it would, therefore, be necessary to make annual or frequent plants. As the species feeds more or less on other game fishes indigenous or previously introduced, a continuation of planting would probably merely substitute a wholly artificial supply of fish for one naturally maintained. A somewhat similar condition exists with respect to one or two other fishes in the lake.

The investigation of lakes in Idaho and Washington, undertaken at the request of State and local authorities, developed interesting facts bearing on the adaptability of the waters for fish culture and the introduction of nonindigenous species. The work will be completed and reported on early in the next fiscal year. Work on similar lines was conducted in Wisconsin in cooperation with the Wisconsin geological and natural history survey.

The investigation of the Illinois River with special reference to the effects on fish life of the sewage discharge and the drainage changes induced by the Chicago drainage canal, begun in the preceding fiscal year in cooperation with the natural history survey of Illinois, has been continued. It has been found that in the upper part of the river the conditions are essentially those of a septic tank, the stream practically devoid of oxygen and therefore of fish. In the lower part the conditions gradually improve through the oxygenation of the water, and fish are found in increasing numbers. The results of this work when completed will have wide application to the conservation of fishes in sewage-laden streams throughout the country.

Investigations in the Truckee River Basin showed that owing to changes in the drainage due to irrigation projects the current in the lower river had been checked and diverted to such an extent as to interfere seriously with the migration of certain fishes which constitute a valuable food supply, especially to the Indians. The inpounding of the water of Lake Tahoe and the diversion of large quantities at

Derby and other places, and especially the wastage of water, has reduced the level of the river in many places to such an extent as to prevent the passage of fish, and in the spring of 1912 thousands of dead trout, from 2 to 3 feet long, were strewn along the bars and clogged the ripples. These largely preventable conditions resulted in the loss of tons of valuable food fishes.

FISH DISEASES.

During the fiscal year the usual number of diseases developed among the fishes at the several hatcheries, but as the Bureau is not provided with a regular pathologist nothing could be done toward study and alleviation of the trouble. The makeshift previously adopted of detailing to this work for limited periods an expert whose services were urgently required for other duties pertaining more strictly to his position was no longer feasible.

It has been possible to make tests of water suspected to be inimical to fishes and to cooperate in a minor capacity with a State institution in the study of the tumor disease prevalent in trout. The latter work has reached a stage in which concentrated effort to that end would probably soon result in the discovery of a remedy, but the Bureau's collaborators are primarily interested in other phases of the investigation and the Bureau is hampered by the lack of an assistant qualified for this highly specialized research. In the interests of economy of operation of the Government hatcheries, and to the end of saving much valuable food now in the streams, the Bureau should be provided with means for carrying on research concerning the diseases of fishes and the methods by which they may be rendered less destructive.

STUDIES OF PACIFIC COAST SALMONIDÆ.

The investigations respecting the salmons of the Pacific coast, to which reference has been made in previous reports, have furnished long-sought information concerning important facts in the life history of these fishes. These results have been obtained by the recently developed method of studying the scales, by means of which many facts in the actual history of individual fishes may be determined, and by the multiplication of such studies valuable data concerning the composition of schools or runs of the species are obtained.

In these investigations it has been learned that the various species of Pacific coast salmon differ more or less in the age of maturity, and that moreover the runs of some species are not homogeneous in their composition but contain varying proportions of individuals younger and older than the normal. Various other facts bearing on the relative proportion of the life of these fishes spent in the rivers and the sea respectively are being developed by the inquiry and will be shown in forthcoming papers on the subject.

SURVEY OF HALIBUT GROUNDS.

The preliminary survey of the Alaskan halibut grounds begun in May, 1911, was continued until September, and a report on the results has been issued and distributed. The steamer *Albatross*, with a special crew of practical halibut fishermen and with the standard fishing apparatus, was detailed for this work, which had for its object the locating and testing of grounds either not regularly resorted to by fishermen or never as yet visited by them. The grounds examined extended from southeast Alaska to Bering Sea, and numerous fishing trials were made throughout that wide area. While halibut were found in no great abundance on any one ground, many of the experimental sets of trawl lines indicated that commercial fishing would be profitable.

In order to make a thorough survey of the fishing banks of Alaska and determine accurately the areas where halibut occur in paying quantities, several seasons of active work will be required. An entire season could profitably be devoted to each major region, so that all parts of the larger banks may be tested at suitable intervals. The results accomplished are chiefly important because they indicate the lines along which further investigation should proceed. It is the intention of the Bureau to continue this work and to make it as economically useful as possible to the large interests now dependent on the halibut fishery.

FRESH-WATER MUSSEL INVESTIGATIONS.

Investigations in the interests of the pearl-mussel fisheries of the Mississippi Valley, carried on at the Fairport, Iowa, station of the Bureau and in the field in connection with that station, are beginning to yield results. Toward the end of the fiscal year facts were developed which lead to the opinion that it will soon be possible to propagate the "wartyback" and the "niggerhead," two of the most important button shells of the Mississippi and its tributaries, which hitherto have not responded to cultural methods.

During the spring of 1912 the excessive and long-continued high water in the Mississippi prevented the culture of mussels on a large scale. In the latter part of June, however, the river conditions became more favorable, a number of millions of young mussels were liberated at the Fairport and Homer stations, and the results attained up to that time indicated successful operations during the remainder of the summer. As the fishes used for the purpose of inoculation with the mussel larvæ are rescued from sloughs and shallows in which they would die during the low-water stages of summer and fall, this work serves the double purpose of conserving food resources and increasing the raw material for the button industry. Field investi-

gations of the natural mussel resources of the streams and of the conditions in respect to the possibility of their improvement were made in Oklahoma, Arkansas, Kentucky, Tennessee, and Illinois during the year. As the preparation of full reports involves the examination of much material and data, the Bureau has recently adopted the policy of issuing on completion of the field work a brief summary of the facts of immediate importance to the mussel fishermen and the button manufacturers. New sources of supply of pearly mussels have been opened up through the Bureau's investigations.

INVESTIGATION OF THE CHESAPEAKE BASIN.

At intervals during the year research has been conducted into the growth and life histories of the shad, herrings, and other food fishes of the Chesapeake Basin in order to acquire data on which to base recommendations for the increase and improvement of the fish supply. Chesapeake Bay, by reason of its physical and biological characteristics, and its location with respect to the great centers of population, is the largest producer of sea food within the territorial limits of the United States and is exploited to a degree which requires careful administration for the preservation of its resources.

Inquiries conducted in the upper part of the bay showed that considerable quantities of mature and immature food fishes were used in the production of fertilizer. This abuse is especially prevalent in Maryland, the fish being disposed of to vessels from Virginia, in which State the laws against the practice are stringent.

WORK AT BIOLOGICAL STATIONS.

The activities of the Fairport, Iowa, station have been epitomized in connection with the description of pearl-mussel investigations.

The Beaufort, N. C., laboratory was in operation with a full force of permanent and temporary investigators and assistants during the summer of 1911. During the remainder of the year work was carried on by the permanent personnel, particularly in the continuation of experiments in the breeding and culture of diamond-back terrapin.

The Bureau has now a brood stock of terrapin from various localities between Chesapeake Bay and Texas, and about 1,700 young hatched in captivity. Little difficulty has been encountered in hatching and raising the young, and although the experiment has not yet been of sufficient duration to show final results, the rate of growth and the small expense of feeding and care give every promise of the early development of a commercially profitable industry. Operations on a large scale and the undertaking of similar economic work with other aquatic food animals is prevented by the lack of a fish and terrapin culturist who can devote himself to the experiments, unhampered by other duties.

The laboratory at Woods Hole was open during the customary season and its facilities were afforded to a large number of investigators engaged in marine biological research. The assistants of the Bureau, most of whom were employed only temporarily, were engaged in various economic applications of the results of research, prominent among them being the investigation of fish oils, the effects of poisons and industrial wastes on fishes, fish parasites and their pathological effects, oyster enemies, the habits of fishes, etc.

ALASKA FISHERIES AND FUR RESOURCES.

The salmon, fur-seal, and other fisheries, and the minor fur resources of Alaska have heretofore been dealt with in the Division of Inquiry Respecting Food Fishes and the Fishing Grounds, but under date of July 1, 1911, a new division, provided for by law, came into existence, under the name of Alaska Fisheries Service, to which will hereafter be assigned all matters pertaining to the fisheries and fur industries of the Territory. A special field and office personnel, headed by a chief of division, has been organized to execute the important practical and scientific duties thus imposed on the Bureau, and a new era of great importance for Alaska and of augmented responsibility and usefulness for the Bureau has begun.

ALASKA SALMON SERVICE.

Full details regarding the administration of the salmon and other fisheries of Alaska will be found in a special report issued as a separate document. As complete returns from these fisheries are not obtainable until the late fall or early winter of each year, the information here presented is for the calendar year 1911. For the purpose of enforcing the salmon laws and the regulations made thereunder, there has been the usual inspection of fishing apparatus and methods, and information regarding all branches of the fishing industry have been obtained and appear in the special report.

The measures adopted by Congress and the Department for the protection and preservation of the salmon have been well received by the fishing interests and, with rare exceptions, have been respected throughout the vast territory. Under existing conditions of control and certain additional legislation now being considered by Congress, there is little reason to doubt that the salmon fisheries in all parts of Alaska may be preserved unimpaired for many generations.

The run of salmon in 1911 varied considerably in different parts of Alaska, being exceptionally good in the southeastern region, fair in the central, and poor in the western. The fishery as a whole was more productive than ever before, but this was owing to an unprecedented catch of the cheaper species of salmon, while the take of sockeye or red salmon declined. The net increase over 1910 was

over 10,000,000 fish, and the pack of canned salmon was the largest in the history of the Territory. The aggregate catch was over 43,975,000 fish, from which there were prepared 2,825,000 cases of canned salmon each containing forty-eight 1-pound cans or the equivalent, valued at $14,593,000, in addition to which salmon were sold in a fresh, frozen, pickled, dry-salted, or smoked condition to the value of about $535,000. The number of salmon canneries increased from 52 to 64, the largest number of new plants being in southeastern Alaska. The success of a floating cannery in that section resulted in the equipment of several other such plants in anticipation of the 1912 season.

In the fall of 1911 the five private salmon hatcheries took 167,146,800 eggs of the red salmon; adding to these the take of the two Government hatcheries, amounting to 102,520,000 eggs of red salmon and 6,696,700 eggs of humpback and silver salmons, the total for the season was 276,363,500. Under the provision of law exempting from license fee and taxation the owners of private hatcheries at the rate of 10 cases of salmon for each thousand red or king salmon fry hatched and liberated, there were planted in 1911 salmon fry to the number of 106,617,500, on which the rebate was $42,647. This feature of the Alaskan fishery law has been the subject of complaint and criticism, and should probably be replaced by a provision placing all fish-cultural work under the direct control of the Bureau.

Under date of March 21, 1912, the Secretary of Commerce and Labor established and promulgated the following regulations affecting the waters of Afognak Island, which was set aside as a public fish-cultural reservation by presidential proclamation in 1892; these regulations were designed to safeguard the fish supply and at the same time accord to the native inhabitants of the island certain privileges not incompatible with the purpose for which the reservation was established:

1. No person or persons other than the natives of Afognak Island now resident thereon will be permitted to fish in the reserved waters.

2. Licenses for fishing will be granted to the said natives upon application to the Secretary of Commerce and Labor or such representative of the Department of Commerce and Labor as may from time to time be designated by the Secretary.

3. The kinds and amounts of apparatus to be used, the places where and the manner in which it may be operated, and the time when it may be employed, will be determined by the Secretary of Commerce and Labor and will be subject to changes or modifications from time to time at his discretion.

The order of the Secretary of Commerce and Labor of December 19, 1907, closing Wood and Nushagak Rivers to salmon fishing, remains in force, and no commercial fishing has been carried on in these streams or within 500 yards of their mouths except that allowed in 1911 as a scientific test of the run of fish. The acquies-

cence of the salmon canners in this order has been complete, and is typical of the almost universal observance of the laws and regulations adopted for the preservation of the industry. With the cooperation of the firms operating canneries in Nushagak Bay, Wood River was racked as during the three preceding years and a tally was kept of the spawning salmon ascending to Lake Aleknagik. The number of fish thus counted was 354,000, and the number caught in the bay was 2,846,000, both figures being much lower than in any of the other years. Until the observations have covered at least one more season, no definite conclusion can be drawn as to the significance of the figures obtained.

The usual statistical canvass of the Alaska fisheries showed 17,900 persons engaged in the industry, $22,671,000 invested, and products valued at $16,863,000 as sold. The round or fresh weight of the fish taken was 256,000,000 pounds, and the weight of the prepared fish and other products was over 177,570,000 pounds. The aggregate round weight of salmon, amounting to upward of 207,600,000 pounds, was far in excess of that of all other fishes combined. Next in quantity came halibut, 21,894,000 pounds; herring, 21,157,000 pounds; and cod 4,800,000 pounds. The halibut fishery gave employment to 650 persons and represented an invested capital of over $1,000,000, with a prepared output of 17,300,000 pounds, valued at $822,000, a decrease of 4,265,000 pounds compared with 1910 but a small increase in value owing to greater demand and higher prices. The herring fishery, carried on chiefly in southeastern Alaska, gave employment to 265 persons and $295,000 in invested capital, and had an output valued at $202,000. Formerly all herring taken were converted into oil and fertilizer, but a conspicuous part of the yield in 1911 was used for food and bait in a fresh, frozen, pickled, or dry-salted condition.

A feature of the Alaska fisheries is a growing appreciation of the value of products formerly regarded as useless, and the equipment of a number of small experimental plants designed to utilize such materials.

FUR-SEAL SERVICE.

The international convention concluded between the United States, Great Britain, Russia, and Japan with reference to the fur seals came into practical effect in the spring of 1912. The sealing operations on the Pribilof Islands during the season of 1911 were conducted, as in the previous year, under the direct control of the fur-seal agents of the Bureau. The herd was subject to the usual ravages of pelagic hunters up to December 15, 1911.

The regulations adopted under the law limited the killing to young male seals with skins weighing not less than 5 pounds and not

more than $8\frac{1}{2}$ pounds green, which limits embraced pelts from 3-year-old or the larger 2-year-old bachelor seals. No killing was permitted until there had been made a reservation of 1,000 of the finest 3-year-old males for breeding purposes. No quota of seals to be killed was decided on in advance, as it was the policy to take only such seals of killable size and age as remained after the reservation had been made.

The number of skins shipped in 1911 was 9,554 from St. Paul Island and 2,448 from St. George, a total of 12,002.[1] These were sent to London and sold at public auction on December 15, 1911, by Messrs. C. M. Lampson & Co., who acted as agents for the Government in the matter. The net proceeds of the sale were $385,862.28, for which sum a certified check was duly received and covered into the Treasury. Under the leasing system which prevailed prior to 1910 the Government would have received only $122,720.45 for the season's take.

MINOR FUR RESOURCES.

The blue-fox herds on the Pribilof Islands were managed by the Government for the first time in the winter of 1910-11. The skins taken were shipped to London with the fur-seal skins and sold under the same auspices on March 18 and 19, 1912. The consignment consisted of 371 blue skins and 20 white skins, and the net proceeds therefrom were $15,096.58. Some of the blue-fox skins brought $85 apiece, and the average price was over $44. The Bureau is making special efforts to improve the stock of foxes and the methods of handling the herds. The results of experiments in feeding and selective breeding that are now in progress give reason to believe that the output can be greatly increased and the quality of the fur enhanced.

To enable the Department to carry out the duties with reference to the fur-bearing animals of Alaska imposed by the act of April 21, 1910, Congress has provided for a small force of wardens (one chief warden and four deputies), who have been duly selected and appointed and have been in the field continuously since the summer of 1911. The wardens have been assigned to the more important fur-producing regions, where they live with the hunters and trappers, study their methods, advise them as to the requirements and objects of the laws, make investigations of the habits and distribution of the different fur-bearing animals, and note the condition of the fur of each species in each month in order to determine for each region when that fur is prime. A further duty of the wardens is to create

[1] By inadvertence 4 skins taken from Japanese poachers July 30, 1910, and shipped to London with the consignment of that year were stated in the annual report of the Alaska Fisheries Service (Bureau of Fisheries Document No. 766) to have been included in the shipment for 1911. The actual number shipped in 1911 was 12,002, not 12,006 as stated on page 95 and indicated on page 96 of that document.

among buyers of pelts a sentiment against the handling of unprime skins, and to show the native hunters and trappers that their own interests require the enforcement of such regulations as will maintain the supply of fur-bearing animals.

An arrangement has been made with the governor of Alaska whereby the laws pertaining to both fur-bearing and game animals will be more effectively enforced. Five of the Alaska game wardens have been appointed special fur wardens for the Department and given a nominal salary, and the five wardens of the Department have been appointed special game wardens for Alaska, the special wardens in each case being vested with all the authority possessed by the regular wardens.

FISHERY MATTERS IN CONGRESS.

During the year various matters of importance to the Bureau of Fisheries and the fishing industry of the country were under consideration by Congress.

Numerous bills providing for the establishment of new fish-hatching stations in all parts of the country were introduced and considered by appropriate committees. In the case of most of the bills the Department, on request, gave to the committees an expression of opinion as to their merits and the desirability of their passage. A number of the measures were favorably reported and acted on by one House, but none had been enacted into law by the end of the fiscal year. The restrictions advocated by the Department and Bureau in the establishment of fish hatcheries, the necessity for which has been shown in previous years, have been accepted by committees of Congress and inserted in nearly every bill reported.

The Senate Committee on Fisheries held protracted hearings on a bill amending the present laws affecting the fisheries of Alaska and the functions of the Department in connection with the protection and administration of the industry. The bill has been prepared because of the belief among the fishery interests, which is confirmed by the experience of the Bureau, that the existing laws need revision in order to meet present requirements and to provide more adequately for future conditions.

In a bill providing for a territorial form of government for Alaska which was favorably considered by both Houses of Congress and enacted into law early in the fiscal year 1913, there was a provision that the territorial legislature should have no authority to alter, amend, modify, or repeal laws relative to fish, fur seals, and other fur-bearing animals.

The act of June 20, 1906, for the protection of the sponge fisheries of the United States, having been found to be very difficult of enforcement, a new bill covering this subject was introduced in the Senate

April 17, 1912, and was passed by that body early in the next fiscal year. The measure makes new regulations covering the use of diving apparatus in the Florida sponge fishery, and if enacted into law will prohibit citizens of the United States from taking sponges by diving except between October 1 and July 1 of each year in depths of 40 to 150 feet, and will also prohibit the taking at any time of sponges less than 5 inches in diameter. The Bureau has for many years been solicitous for the welfare of the sponge fishery and regards this legislation as necessary for the perpetuity of the industry.

In May, 1912, the House Committee on the Merchant Marine and Fisheries had a hearing on a bill which would have the effect of prohibiting the method of fishing known as beam trawling or otter trawling. This fishery is of comparatively recent origin in the United States and is of very limited extent, being practically restricted to a few vessels making their headquarters at Boston. The method is strongly opposed by the line fishermen of New England on the ground that it is very destructive. In the course of the hearing it became apparent that there was a marked difference of opinion regarding the effects of the trawl-net fishery. The Deputy Commissioner of Fisheries, in a statement made to the committee on behalf of the Bureau, took the position that the question presents too many important phases to be disposed of without the fullest consideration; that the information on which Congress can act advisedly does not exist; and that authority should be given for an impartial inquiry by the Bureau. The committee accepted this view, adjourned the hearing, and submitted a favorable report on a joint resolution, providing that "the Commissioner of Fisheries be, and he is hereby, authorized and directed to make an investigation into the method of fishing known as otter and beam trawling and to report to Congress whether or not this method of fishing is destructive to the fish species or is otherwise harmful or undesirable," and "in the event that the Commissioner finds this method of fishing to be destructive, harmful, or undesirable he shall recommend to Congress such legislation as he may deem necessary."

A bill carrying out the articles of the convention between the United States, Great Britain, Russia, and Japan for the protection of the fur seal and sea otter of the North Pacific Ocean was passed by the House of Representatives on February 14, 1912, after hearings before the Committee on Foreign Affairs, at which representatives of the Bureau testified. The bill reaffirmed the provisions of the treaty ratified by the Senate on July 7, 1911, which became effective December 15, 1911, and in addition contained clauses affecting the taking of seals on land. At the close of the fiscal year no action had been taken on the measure by the Senate. Hearings on the fur-seal service before the House Committee on Expenditures in the Department of

Commerce and Labor were continued throughout the fiscal year, and have not yet been concluded. Up to June 30, 1912, 29 hearings had been held and the printed testimony had been issued in 13 parts, comprising 896 printed pages.

The question of Federal control over migratory birds is covered by several bills pending in Congress. During hearings on these bills, arguments were incidentally presented by State officials and others favoring the extension of Federal jurisdiction so as to cover migratory fishes. The serious condition of the fish supply in some interstate streams, and the apparent inability of the States to afford adequate protection, appear to warrant this appeal to Congress.

The diplomatic and consular appropriation act for the fiscal year ending June 30, 1913, contains an item authorizing the participation of the United States in the Permanent International Council for the Exploration of the Sea. The bill carries an appropriation for the pro rata share of this country in the administrative expenses of the council and for other purposes, including the attendance "of an expert official representative at the annual meeting." Reference has been made in a previous report to the purposes, organization, and work of this council, and to the official invitation to join the council, extended to the United States Government several years ago. The matter comes under the jurisdiction of the Department of State, but the necessary cooperative and independent investigations growing out of this affiliation with the nations of Europe will be conducted by this Bureau.

MISCELLANEOUS RELATIONS AND ACTIVITIES.

NEW STATIONS AND IMPROVEMENTS.

Recognizing the value and efficiency of the Bureau's work in maintaining and increasing the supply of native food fishes, Congress has authorized the establishment of new fish-cultural stations in Kentucky, South Carolina, and Wyoming. Investigations have been made looking to the selection of sites for these stations, and locations have been decided on at Louisville, Ky., Orangeburg, S. C., and Saratoga, Wyo. It is expected that construction work on these stations will have progressed sufficiently to enable practical operations to begin by the close of the fiscal year 1913.

By authority of the act of January 29, 1909, authorizing the construction of two or more salmon-culture stations in the Puget Sound region, two stations (Quilcene and Duckabush) have been completed and opened for work, land has been acquired for a station (Birdsview) operated as an auxiliary of the Baker Lake hatchery, and there has been an examination of a site at Darlington with a view to the establishment of a fourth station within the limits of the original appropriation.

At Homer, Minn., a hatchery building 20 by 55 feet, with hatching room, laboratory, offices, etc., has been erected, together with a cottage and other necessary buildings.

At the Leadville, Colo., station a foreman's house, boiler house with work rooms and shops, a barn, and other necessary buildings were constructed, and improvements were made to the ponds and grounds.

At the Fairport, Iowa biological station two additional cottages, a barn, and tank house have been built, and filtering plant, cisterns, pipe lines, culvert, and other additions to the water system have been completed. Plans are ready for a laboratory 50 by 100 feet and a contract for its construction will soon be let.

The establishment of a biological station on the Gulf coast of Florida was authorized by Congress, in an act approved March 1, 1911, the cost not to exceed $50,000, and an initial appropriation of $25,000 was made for the purpose in the sundry civil act for 1912. The act of authorization provides that the State of Florida shall donate and transfer, free of cost, to the United States the necessary land and water rights required for the laboratory. Pursuant to this provision the Florida legislature, by act approved June 3, 1911, took steps for the acquisition of a site by creating a commission to confer with the Secretary of Commerce and Labor regarding the selection. A number of sites have been examined, but no final selection has yet been made.

VESSEL SERVICE.

While the steamer *Albatross* was engaged in investigation of cod and halibut grounds in the north Pacific Ocean during the summer of 1911, reported upon elsewhere, it was discovered as the result of a survey by a board of officers that the ship was in bad condition, the iron deck and plates in the hull being badly corroded. Further examinations on arrival at Sausalito developed the fact that the condition was even worse than was supposed; so bad, in fact, as to make it dangerous for the vessel to go to sea. The original construction of the ship was so good, however, and she is still so strong generally, that it was considered highly desirable to ask for a special appropriation for comprehensive repairs and refitting. This was not granted during the year and will be again recommended. Meantime the work of the *Albatross* has been confined since last autumn to a biological survey of San Francisco Bay.

The steamer *Fish Hawk* was occupied during the summer of 1911 at Woods Hole in connection with the biological work, and late in October was sent to the yard of the Pusey & Jones Co. at Wilmington, Del., with which firm a contract had been entered into for extensive repairs. During the winter and early spring the vessel was thor-

oughly overhauled, all of the upper works above the iron hull being removed and replaced with new material. A new boiler was installed, engines put in first-class condition, new interior fittings provided, and certain modifications made in the arrangement of space which will add to the efficiency and convenience of the vessel. As the iron hull is considered to be as good as when built, it is believed that many years' service can be expected from the *Fish Hawk* with no extraordinary expenditures.

The schooner *Grampus* and the smaller vessels of the Bureau have been engaged as heretofore in fish-cultural work in connection with the various stations.

PUBLICATIONS AND LIBRARY.

A new series of publications of the Bureau has been established in a form designated "Economic Circular." These brief papers are intended primarily to be the medium of prompt report upon the main features and practical results of work for which a more complete account requiring much more time in preparation will appear later. Economic Circular No. 1, "Condition of the mussel beds of the Cumberland River in 1911," issued February 13, 1912, and distributed among the mussel fishermen and button makers, was the only paper of this series issued during the past fiscal year, but others of the same character were ready to appear shortly thereafter. Through this series of circulars it will also be possible to publish brief notices of other important subjects not requiring detailed investigation or discussion but valuable as information in particular branches of the fishing industries.

The following documents relating to the Bureau's work were issued during the year and seven of previous issue were reprinted:

Natural history of the American lobster. By Francis H. Herrick. From Bulletin, vol. XXIX, 1909, p. 149–408, pl. XXVIII–XLVII, 42 text fig. Document 747, issued July 28, 1911.

Special investigation of the fur-seal rookeries in 1910. By Harold Heath. Document 748, 22 p., issued November 10, 1911.

The fur-seal fisheries of Alaska in 1910. By Walter I. Lembkey. Document 749, 40 p., issued November 8, 1911.

The salmon fisheries of the Pacific coast. By John N. Cobb. Document 751, 182 p., issued November 25, 1911.

Effects of explosive sounds such as those produced by motor boats and guns upon fishes. By G. H. Parker. Document 752, 10 p., issued October 12, 1911.

Report of the Commissioner of Fisheries for the fiscal year ended June 30, 1911. Document 753, 70 p., issued February 23, 1912.

Fishes from Bering Sea and Kamchatka. By C. H. Gilbert and C. V. Burke. From Bulletin, vol. XXX, 1910, p. 31–96, 37 text fig. Document 754, issued May 6, 1912.

Sound as a directing influence in the movements of fishes. By G. H. Parker. From Bulletin, vol. XXX, 1910, p. 97–104. Document 755, issued April 27, 1912.

Studies on the reproduction and artificial propagation of fresh-water mussels. By George Lefevre and Winterton C. Curtis. From Bulletin, vol. xxx, 1910, p. 105-202, 4 text fig., pl. VI-XVII. Document 756, issued May 10, 1912.

The mussel fauna of the Maumee River. By Charles B. Wilson and H. Walton Clark. Document 757, 72 p., 2 pl. Issued April 22, 1912.

The mussel fauna of the Kankakee Basin. By Charles B. Wilson and H. Walton Clark. Document 758, 52 p., 1 pl., 1 chart, issued March 19, 1912.

The mussels of the Big Buffalo Fork of White River, Arkansas. By Seth E. Meek and H. Walton Clark. Document 759, 20 p., issued March 19, 1912.

The Bryozoa of the Woods Hole region. By Raymond C. Osburn. From Bulletin, vol. xxx, 1910, p. 203-266, pl. XVIII-XXXI. Document 760, issued June 25, 1912.

There have been 535 additions to the main library during 1912, of which 405 were acquired by gift, 115 by purchase, and 15 by transfer from the Library of Congress. The additions to the working collections of books at the biological stations at Woods Hole and Fairport number 280 and 200, respectively. Satisfactory progress has been made in cataloguing and in recataloguing, cards for all documents that have appeared in the Bulletin of the Bureau being about completed. As these cards, printed by the Library of Congress, are analytical, they will be valuable not only in the various libraries of the Bureau but in all libraries in which its publications are deposited.

INTRODUCTION OF REINDEER ON SEAL ISLANDS.

An interesting experiment which has proved highly successful was the introduction of reindeer on the Pribilof Islands, where these animals, it was believed, could become an important factor in the natives' economy, furnishing milk, meat, and hides and being useful also as burden carriers. With the aid of the Department of the Interior, through the Bureau of Education, 40 reindeer were secured and taken to the islands by revenue cutter in August, 1911, 25 being landed on St. Paul and 15 on St. George. The supply of reindeer moss and other food was adequate, and the herd passed through the winter in excellent condition. Twenty-eight healthy fawns were born in the spring, and it is believed that from the present nucleus a considerable herd of reindeer will become a permanent addition to the island resources.

FISHERY INTELLIGENCE SERVICE FOR PACIFIC COAST.

The Bureau has for many years maintained at Boston and Gloucester, Mass., the two principal fishing ports on the northern Atlantic coast, a service for collecting and diffusing information regarding the extent and condition of the vessel fisheries centering there. In compliance with the recommendations of the Bureau, Congress has authorized a similar service for Seattle, the principal fishing port on the Pacific seaboard, by providing for a local agent. Steps have been taken to institute this service, but difficulty in securing a properly qualified man has delayed the inauguration of the work.

ENFORCEMENT OF FOOD AND DRUGS ACT.

The Bureau of Chemistry of the Department of Agriculture, which is intrusted with the enforcement of the food and drugs act of June 30, 1906, has from time to time forwarded to the Bureau of Fisheries for examination numerous samples of fishery products of foreign and domestic origin which have been collected or seized in all parts of the country. Reports on such samples have been duly submitted for the information and guidance of the Food and Drugs Board in proceeding against violators of the law. The expert assistance of the Bureau has been sought primarily for the purpose of identifying fishery foods, of passing on the propriety of brands and labels, and of determining the wholesomeness of special products. Representatives of the Bureau have attended hearings, made depositions, and given expert testimony in court trials.

APPROPRIATIONS.

The total appropriations for the Bureau for the fiscal year 1912 amounted to $1,132,990, as follows:

Salaries	$379,990
Miscellaneous expenses:	
Administration	10,000
Propagation of food fishes	325,000
Inquiry respecting food fishes	35,000
Statistical inquiry	7,500
Maintenance of vessels	60,000
Protecting seal and salmon fisheries	100,000
Protecting sponge fisheries	5,000
Specials:	
Steamer *Fish Hawk*, repairs	28,000
Steamer *Albatross*, wireless apparatus	2,500
Continuation of construction—	
Biological station, Fairport, Iowa	50,000
Fish-cultural station, Homer, Minn	27,000
Repairs, biological station, Beaufort, N. C	3,000
Establishment of fish-cultural stations—	
South Carolina	25,000
Kentucky	25,000
Wyoming	25,000
Establishment of biological station, Gulf coast of Florida	25,000

An itemized statement of expenditures authorized by the foregoing appropriations has been made, as required by law.

RECOMMENDATIONS.

Recommendations previously made in regard to the establishment of additional hatching stations are renewed. Recent experience has emphasized this need, which is becoming more pressing each year. Special urgency for increased fish-cultural facilities exists in the

southern and southwestern States, where desirable food fishes suitable for pond culture can be produced in almost unlimited numbers, for the stocking of waters in all parts of the country. The demand for the black basses and other fishes of similar habits is so great and insistent that the Bureau is becoming more and more embarrassed by its continued inability to meet it, owing to lack of suitable stations. A number of additional hatcheries for the migratory food fishes of the coastal rivers could be operated to excellent advantage in various sections, including Alaska, where, in the Bristol Bay region, there is urgent demand for one large station, while in southeastern Alaska a number of smaller plants are required.

One of the most important services that Congress can now render to the fisheries is to give to the Bureau the means of carrying on comprehensive studies of fish diseases and fish breeding. The establishment of a fishery experiment station for this purpose can not be too strongly advocated, and the representations on this subject contained in last year's report of the Bureau are repeated.

There is likewise need for a biological station on the Pacific seaboard, with suitable facilities for the study of important fishery problems and for marine fish culture, and previous recommendations hereon are renewed.

In the estimates submitted to Congsess, provision has been made for a new steam vessel for use in connection with the fur-seal, salmon, halibut, and other fisheries of the Pacific coast, where the Bureau's operations are rapidly becoming more important and extensive. This vessel, to cost approximately $225,000, is required in order to properly carry out the duties imposed by law.

The successful condition and outcome of the Bureau's work in its various fields and phases may be attributed largely to the faithful and efficient service rendered by the administrative and technical employees in Washington, at stations, on vessels, and in the field. In commending to the Secretary the chiefs and subordinates for their loyal support and cooperation, the Commissioner renews this frequently repeated recommendation: That the salaries paid throughout the Bureau be readjusted, to the end that present inconsistencies and injustices may be corrected, and that every employee may receive the compensation demanded by changed economic conditions and merited by individual capacity and responsibility.

Respectfully,

GEO. M. BOWERS,
Commissioner.

To Hon. CHARLES NAGEL,
Secretary of Commerce and Labor.

THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1912.

Bureau of Fisheries Document No. 770

CONTENTS.

INDEX TO SPECIES DISTRIBUTED.

THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1912.[a]

CHARACTER OF THE WORK.

More than 95 per cent of the output of the fish-cultural stations consists of important commercial species, notably the salmons, shad, whitefish, pike perch, yellow perch, white perch, lake trout, cod, pollock, flatfish, and lobsters. These are hatched in lots of many millions annually and planted by the Bureau, the fresh-water species principally in the large coastal streams and in the Great Lakes, the marine species upon the inshore fishing grounds of the Atlantic.

The cultivation of the fishes of the interior waters, generally classed as game fishes, although a comparatively small factor in the total output, is a very important feature of the Bureau's work, supplying as it does various kinds of young fish for public streams, lakes and ponds, fishing preserves, private ponds, private streams, etc., in all parts of the United States. Among the fishes most extensively produced for these purposes are several species of trout, the grayling, the basses, crappie, bream, and catfish; various others also are handled. The trouts are artificially hatched from eggs taken from both wild and domesticated stock; the basses, catfish, and others are derived from mature fish held in ponds for breeding purposes, or (except the small-mouth black bass) they are rescued from the overflows of the Mississippi and Illinois Rivers. Collections from the latter sources include also pike and pickerel, which are not distributed to applicants but are returned immediately to the main streams.

METHOD OF DISTRIBUTION.

The first consideration in the Bureau's distribution of fishes is to make ample return to the waters from which eggs or fish have been collected. The remainder of the product is consigned to suitable public or private waters upon application indorsed by a United States Senator or Representative, the Bureau furnishing to persons interested an application blank for this purpose. The blank calls

[a] The detailed report of the distribution of fish and eggs for the fiscal year 1911 was not printed. Included in the report for 1912, however, will be found a summary of the distribution and tables of fish and eggs furnished to State fish commissions and to applicants in foreign countries during that year.

for a description of the waters to be stocked, and by this information is determined the species of fish that is suitable and the number that may be allotted to the water area in question. Certain predaceous species, such as the basses and perches, are not furnished for waters inhabited by trout or other valuable fishes to which they would be destructive. Nor, of course, are species like trout and salmon furnished for waters already stocked with fish that would prey upon them.

The fish are carried to their destination in railroad cars equipped for the purpose, or by messengers who accompany the shipments in baggage cars, and are delivered to the applicant free of charge, at the railroad station nearest the point of deposit. The applicant is advised by telegraph when the shipment will arrive, and is expected to make due provision for care of the fish until planted. Definite instructions in this respect are furnished at the time of shipment.

During the past fiscal year (July 1, 1911, to June 30, 1912) the Bureau received 9,446 applications for fish, and a very large per cent of them were for the basses, crappies, sunfishes, and catfishes, for stocking artificial ponds on farms. The demand for such fish has for some time been greater than could be met with available resources.

SIZE OF FISH WHEN DISTRIBUTED.

Fishes are distributed at various stages of development, according to the species, the numbers in the hatcheries, and the facilities for rearing. The commercial fishes—such as the shad, whitefish, lake trout, pike perch, cod, etc., hatched in lots of many millions—are necessarily planted as fry shortly after hatching. Atlantic salmon, landlocked salmon, and various species of trout are reared, in such numbers as the hatchery facilities permit, to fingerlings from 1 to 6 inches in length; the remainder are distributed as fry.[a]

The basses, bream, and other sunfishes are distributed from some three weeks after they are hatched until they are several months of age. When the last lots are shipped the basses usually range from 4 to 6 inches and the sunfishes from 2 to 4 inches in length. The numerous fishes collected in overflow lands—basses, crappie, sunfishes, catfishes, yellow perch, and others—are 2 to 6 inches in length when taken and distributed.

Eggs are distributed only to State hatcheries and, occasionally, to applicants who have hatchery facilities.

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[a] The varying usage in the classification of young fish as to size has caused such confusion and difficulty that the Bureau has adopted uniform definitions, as follows:

Fry=fish up to the time the yolk sac is absorbed and feeding begins.

Advanced fry=fish from the end of the fry period until they have reached a length of 1 inch.

Fingerlings=fish between the length of 1 inch and the yearling stage, the various sizes to be designated as follows: No. 1, a fish 1 inch in length and up to 2 inches; no. 2, a fish 2 inches in length and up to 3 inches; no. 3, a fish 3 inches in length and up to 4 inches, etc.

Yearlings=fish that are 1 year old, but less than 2 years old from the date of hatching; these may be designated no. 1, no. 2, no. 3, etc., after the plan prescribed for fingerlings.

SIZE OF ALLOTMENTS.

The Bureau does not attempt to furnish to any one applicant more than a brood stock of fish for a given private pond or stream, it being expected that these will be protected until they have had time to reproduce. The number of fish in an allotment is, however, a variable quantity, depending upon the species and the age at which distributed. Brook trout, which are distributed both as fry and fingerlings, are allotted in much larger numbers as fry than as fingerlings 3 or 4 inches long. Pike perch, which, owing to their excessive cannibalism, can not be reared and are consequently distributed as fry, may be supplied in lots of half a million, where an equal water area would receive only 200 or 300 young bass from 2 to 5 inches long. These latter larger fish have a much better chance of reaching maturity than have the fry, and the actual value for stocking purposes of a few hundred fingerling bass may therefore equal many thousand times this number of pike perch fry.

SPECIES CULTIVATED.

The species handled by the Bureau in 1911 and 1912 numbered some 50 fishes and the lobster. Of these, the following were artificially propagated:

THE CATFISHES (SILURIDÆ):
- Horned pout, bullhead, yellow cat (*Ameiurus nebulosus*).
- Marbled cat (*Ameiurus nebulosus marmoratus*).

THE SUCKERS AND BUFFALO-FISHES (CATOSTOMIDÆ):
- Small-mouth buffalo-fish (*Ictiobus bubalus*).
- Common buffalo-fish (*Ictiobus cyprinella*).
- Black buffalo-fish (*Ictiobus urus*).

THE SHADS AND HERRINGS (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):
- Common whitefish (*Coregonus albus* and *C. clupeaformis*).
- Lake herring, cisco (*Leucichthys artedi*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tschawytscha*).
- Silver salmon, coho (*Oncorhynchus kisutch*).
- Blueback salmon, redfish, sockeye (*Onchorhynchus nerka*).
- Humpback salmon (*Oncorhynchus gorbuscha*).
- Dog salmon (*Oncorhynchus keta*).
- Steelhead trout, hardhead (*Salmo gairdneri*).
- Rainbow trout (*Salmo irideus*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Blackspotted trouts: Yellowstone Lake trout or cutthroat trout (*Salmo lewisi*); Tahoe trout (*Salmo henshawi*).
- Scotch sea trout (*Salmo trutta*). Introduced species.
- Loch Leven trout (*Salmo trutta levenensis*). Introduced species, propagated in limited numbers for observation.
- Lake trout, Mackinaw trout, longe, togue (*Cristivomer namaycush*).
- Brook trout, speckled trout (*Salvelinus fontinalis*).
- Sunapee trout (*Salvelinus aureolus*).

THE GRAYLINGS (THYMALLIDÆ):
- Montana grayling (*Thymallus montanus*).

THE SMELTS (ARGENTINIDÆ):
- American smelt (*Osmerus mordax*).

THE BASSES, SUNFISHES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis annularis*).
- Strawberry bass, calico bass (*Pomoxis sparoides*).
- Rock bass, red-eye, goggle-eye (*Ambloplites rupestris*).
- Warmouth, goggle-eye (*Chænobryttus gulosus*).
- Small-mouth black bass (*Micropterus dolomieu*).
- Large-mouth black bass (*Micropterus salmoides*).
- Bluegill bream, bluegill sunfish (*Lepomis pallidus*).
- Other sunfishes, chiefly *Eupomotis gibbosus*.

THE PERCHES (PERCIDÆ):
- Pike perch, wall-eyed pike, yellow pike, blue pike (*Stizostedion vitreum*).
- Yellow perch, ring perch (*Perca flavescens*).

THE SEA BASSES (SERRANIDÆ):
- Striped bass, rockfish (*Roccus lineatus*).
- White perch (*Morone americana*).

THE PORGIES (SPARIDÆ):
- Porgy (*Stenotomus chrysops*).

THE CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

THE FLOUNDERS (PLEURONECTIDÆ):
- Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

CRUSTACEANS:
- American lobster (*Homarus americanus*).

After the annual seasons of high water in the Mississippi basin, great numbers of young fish are left in sloughs and pools when the waters have receded, and would eventually die by the drying up of these shallow places in summer or freezing in winter. Large collections are made from such sources, for return to the original stream and, of the most abundant species, also to supplement the hatchery stock for distribution. The fishes so collected in 1912 were as follows:

THE CATFISHES (SILURIDÆ):
- Spotted cat, blue cat, channel cat (*Ictalurus punctatus*). Only limited numbers obtainable.
- Horned pout, bullhead, yellow cat (*Ameiurus nebulosus*).

THE SUCKERS AND BUFFALO-FISHES (CATOSTOMIDÆ):
- Small-mouth buffalo-fish (*Ictiobus bubalus*).
- Common buffalo-fish (*Ictiobus cyprinella*).
- Black buffalo-fish (*Ictiobus urus*).

THE MINNOWS AND CARPS (CYPRINIDÆ):
- Carp (*Cyprinus carpio*). Distributed in rare instances, for waters unsuited to other species.

THE PIKES AND PICKERELS (ESOCIDÆ):
- Pike (*Esox lucius*). Restored to the streams; not distributed.
- Pickerel (*Esox reticulatus*). Restored to the streams; not distributed.

THE BASSES, SUNFISHES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappie (*Pomoxis annularis*).
- Rock bass, red-eye, goggle-eye (*Ambloplites rupestris*).
- Warmouth, goggle-eye (*Chænobryttus gulosus*).
- Large-mouth black bass (*Micropterus salmoides*).
- Small-mouth black bass (*Micropterus dolomieu*).
- Bluegill bream, bluegill sunfish (*Lepomis pallidus*).
- Other sunfishes, chiefly *Eupomotis gibbosus*.

THE PERCHES (PERCIDÆ):
- Yellow perch, ring perch (*Perca flavescens*).

THE CROAKERS (SCIÆNIDÆ):
- Fresh-water drum, sheepshead, gaspergou (*Aplodinotus grunniens*). Only limited numbers obtainable; not distributed.

THE SEA BASSES (SERRANIDÆ):
- White bass (*Roccus chrysops*).
- Yellow bass (*Morone interrupta*).

THE SMELTS (ARGENTINIDÆ):
- American smelt (*Osmerus mordax*).

Certain introduced species are propagated to a limited extent, as follows:

THE MINNOWS AND CARPS (CYPRINIDÆ):
- Goldfish (*Carassius auratus*). Propagated for ornamental purposes; not distributed.
- Ide (*Leuciscus idus*). Cultivated variety, golden ide. Propagated for ornamental purposes; not distributed.

SUMMARIZED STATEMENTS OF DISTRIBUTION.

The following tables summarize the number of eggs and fish actually distributed during the fiscal years 1911 and 1912, or in other words, the output of the hatcheries with all losses in transportation deducted.

SUMMARY BY SPECIES OF THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEARS 1911 AND 1912.

FISCAL YEAR 1911.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfish			358,540	358,540
Carp			1,425	1,425
Buffalo-fish		1,200,000	233,514	1,433,514
Shad		91,521,000		91,521,000
Whitefish	61,010,000	301,563,750		362,573,750
Lake herring		4,600,000		4,600,000
Silver salmon	2,391,900	6,216,096		8,607,996
Chinook salmon	37,314,514	16,739,804	322,360	54,376,678
Blueback salmon	1,500,000	100,490,900		101,990,900
Humpback salmon		460,150		460,150
Dog salmon		69,000		69,000
Steelhead trout	660,000	3,870,794	63,875	4,594,669
Rainbow trout	1,202,100	915,660	1,881,553	3,999,313
Atlantic salmon		2,854,084	23,000	2,877,084
Landlocked salmon	331,000	234,221	177,683	742,904
Blackspotted trout	1,496,000	420,026	3,107,500	5,023,526
Loch Leven trout			68,125	68,125
Lake trout	6,587,500	18,801,950	1,931,500	27,320,950
Brook trout	455,500	6,793,545	5,341,607	12,590,652

SUMMARY BY SPECIES OF THE DISTRIBUTION OF FISH AND FISH EGGS DURING THE FISCAL YEARS 1911 AND 1912—Continued.

FISCAL YEAR 1911—Continued.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Sunapee trout	10,000	79,685	10	89,695
Grayling	155,000	1,842,670		1,997,670
Crappie and strawberry bass			147,269	147,269
Rock bass			82,941	82,941
Warmouth bass			200	200
Small-mouth black bass		614,000	102,537	716,537
Large-mouth black bass		8,000	497,592	505,592
Sunfish (bream)			470,667	470,667
Pike perch	424,000,000	278,030,000		702,030,000
Yellow perch	6,200,000	434,691,150	11,116	440,902,266
Striped bass		1,318,000		1,318,000
White perch	15,000,000	427,177,500		442,177,500
Yellow bass			2,451	2,451
Scup		568,000		568,000
Cod		179,311,000		179,311,000
Pollock		114,230,000		114,230,000
Haddock		19,139,000		19,139,000
Flatfish		888,763,000		888,763,000
Lobster		170,631,000	1,571	170,632,571
Total	558,313,514	3,073,153,985	14,827,036	3,646,294,535

FISCAL YEAR 1912.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfish			208,381	208,381
Carp			424,402	424,402
Buffalo-fish		775,000	175,229	950,229
Shad	2,623,000	172,975,000		175,598,000
Whitefish	9,562,500	125,615,000		135,177,500
Lake herring		16,070,000		16,070,000
Silver salmon	2,000	12,955,824	39,875	12,997,699
Chinook salmon	28,697,550	31,040,893	1,496,260	61,234,703
Blueback salmon	2,000,000	80,765,573	10,656,700	93,422,273
Humpback salmon		6,716,325	1,679,300	8,395,625
Dog salmon		2,495,000		2,495,000
Steelhead trout	808,000	4,288,415	404,190	5,500,605
Rainbow trout	1,208,179	660,935	2,265,612	4,134,726
Atlantic salmon		1,841,221	22,711	1,863,932
Landlocked salmon	196,000	297,298	79,152	572,450
Blackspotted trout	6,389,631	1,578,000	6,285,820	14,253,451
Loch Leven trout			66,300	66,300
Lake trout	3,650,000	21,547,700	1,950,660	27,148,360
Brook trout	613,100	4,873,694	5,316,919	10,803,713
Sunapee trout		249,753		249,753
Scotch sea trout			10,572	10,572
Grayling	200,000			200,000
Crappie and strawberry bass			117,303	117,303
Rock bass			65,642	65,642
Warmouth bass			2,971	2,971
Small-mouth black bass		454,500	107,099	561,599
Large-mouth black bass		18,100	485,993	504,093
Sunfish (bream)			228,300	228,300
Pike perch	122,500,000	208,950,000		331,450,000
Pike			4,420	4,420
Yellow perch	8,500,000	474,284,595	5,920	482,790,515
Striped bass		5,356,000		5,356,000
White perch	15,000,000	452,900,000	670	467,900,670
Smelt	27,650,000	9,575,000	100,650	37,325,650
White bass			1,500	1,500
Fresh-water drum			11,720	11,720
Cod		237,123,000		237,123,000
Pollock		290,370,000		290,370,000
Haddock		95,153,000		95,153,000
Flatfish		965,449,000		965,449,000
Lobster		201,728,000		201,728,000
Total	229,599,960	3,426,106,826	32,214,271	3,687,921,057

Allotments of Fish and Eggs to State Fish Commissions for the Fiscal Years 1911 and 1912.

State and species.	1911			1912		
	Eggs.	Fry.	Fingerlings, yearlings, adults.	Eggs.	Fry	Fingerlings, yearlings, adults.
California:						
Chinook salmon	32,952,514			20,525,550		
Grayling				50,000		
Silver salmon	2,289,900					
Colorado:						
Blackspotted trout	200,000					
Brook trout				25,000		
Grayling				25,000		
Rainbow trout				50,000		
Connecticut:						
Brook trout				25,000		
Pike perch	2,000,000			2,000,000		
White perch	15,000,000			15,000,000		
Yellow perch	5,200,000			5,000,000		
Shad					600,000	
Idaho:						
Rainbow trout				76,500		
Illinois:						
Pike perch	8,000,000					
Lake trout	100,000					
Crappie			40			
Sunfish (bream)			250			
Yellow perch			20			
Maine:						
Brook trout				100,000		
Landlocked salmon	200,000			75,000		
Massachusetts:						
Chinook salmon		10,000				10,000
White perch		1,000,000				
Michigan:						
Lake trout	4,000,000			3,000,000		
Landlocked salmon	25,000			25,000		
Smelt				20,400,000		
Whitefish	10,000,000					
Pike perch	50,000,000					
Minnesota:						
Chinook salmon		10,000		10,000		
Lake trout	200,000			250,000		
Landlocked salmon	25,000			10,000		
Steelhead trout	100,000			100,000		
Missouri:						
Brook trout	25,000			30,000		
Rainbow trout	25,000			50,000		
Pike perch	3,000,000			15,000,000		
Yellow perch				2,500,000		
Grayling	50,000					
Montana:						
Blackspotted trout				1,443,000		
Whitefish	500,000					
Nebraska:						
Brook trout						3,000
Rainbow trout	50,000					3,000
Nevada:						
Blackspotted trout	235,000			171,631		
Brook trout	75,000			56,000		
Rainbow trout	25,000			14,369		
New Hampshire:						
Chinook salmon	50,000			25,000		
New Jersey:						
Pike perch					2,500,000	
New York:						
Blackspotted trout				40,000		
Lake trout	100,000			50,000		
North Dakota:						
Steelhead trout	200,000			200,000		
Pike perch	10,500,000					
Blackspotted trout	50,000					
Ohio:						
Pike perch	187,775,000			101,500,000		
Oregon:						
Blackspotted trout	273,000			652,000		
Blueback salmon	1,500,000			2,000,000		
Brook trout				50,000		
Chinook salmon	3,950,000			8,000,000		
Rainbow trout				100,000		

ALLOTMENTS OF FISH AND EGGS TO STATE FISH COMMISSIONS FOR THE FISCAL YEARS 1911 AND 1912—Continued.

State and species.	1911			1912		
	Eggs.	Fry.	Fingerlings, yearlings, adults.	Eggs.	Fry.	Fingerlings, yearlings, adults.
Pennsylvania:						
Lake trout				100,000		
Whitefish	44,000,000					
Pike perch	151,725,000					
Silver salmon	100,000					
Rhode Island:						
Landlocked salmon	20,000					
Utah:						
Lake trout				50,000		
Rainbow trout	100,000					
Steelhead trout	50,000					
Vermont:						
Chinook salmon	50,000		750	100,000		
Silver salmon		5,800				
Lake trout	100,000			100,000		
Landlocked salmon	20,000			15,000		
Brook trout						300
Steelhead trout				58,000		
Washington:						
Brook trout				50,000		
Rainbow trout				100,000		
Wisconsin:						
Whitefish	4,000,000			5,000,000		
Lake trout	2,000,000					
Steelhead trout				100,000		
Wyoming:						
Blackspotted trout	445,000			2,000,000		
Rainbow trout	50,000	4,000		138,500		
Steelhead trout	60,000			100,000		
Grayling	50,000					
Lake trout	25,000			50,000		
Brook trout				150,000		
Total	550,470,414	1,029,800	1,060	206,734,550	3,100,000	16,300

SHIPMENTS OF FISH AND EGGS TO FOREIGN COUNTRIES DURING THE FISCAL YEARS 1911 AND 1912.

Country and species.	1911			1912	
	Eggs.	Fry.	Fingerlings.	Eggs.	Fingerlings.
Austria:					
Rainbow trout				100,000	
Brazil:					
Small-mouth black bass			1,000		
Canada:					
Pike perch		6,000,000			
Cuba:					
Rainbow trout			1,050		
France:					
Rainbow trout				25,000	
Germany:					
Rainbow trout	50,000			50,000	
Japan:					
Brook trout				20,000	
Rainbow trout				90,000	
Portugal:					
Rainbow trout	36,000			50,000	
Sweden:					
Black bass					200
Total	86,000	6,000,000	2,050	335,000	200

DETAILS OF OUTPUT FOR 1912.

Notwithstanding the severe handicap placed upon the Bureau's work by abnormally unseasonable weather during the spawning period of many important species, the egg collections were 225,000,000 in excess of those of the previous year, and the output in round numbers exceeded that of 1911 by 41,000,000 fish and eggs. The species produced in larger numbers in 1912 included the cod, lobster, flatfish, pollock, haddock, shad, cisco, the silver, chinook and humpback salmons, steelhead, rainbow, Sunapee, and blackspotted trout, white perch, yellow perch, striped bass, warmouth bass, white bass, fresh-water drum, and smelt.

The following table shows the work of the different stations in 1912, the period of operation, and the eggs and fish delivered by each station for distribution. It will be noted that transfers of eggs and fish from station to station are frequent, serving economy and convenience in transportation where the shipment consists of eggs, and giving advantageous distributing centers in the case of young fish.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912.

Station and period of operation.	Species.	Output.			Total.
		Eggs.	Fry.	Fingerlings, yearlings, and adults.	
Afognak, Alaska:					
Entire year	Blueback salmon		7,738,000	10,656,700	18,394,700
	Humpback salmon		4,150,000	1,679,300	5,829,300
Baird, Cal.: [a]					
Entire year	Brook trout			47,000	47,000
	Chinook salmon	60,000	7,243,325		7,303,325
	Rainbow trout		10,080		10,080
Battle Creek, Cal.:					
Dec.-Jan.	Chinook salmon	11,090,000			11,090,000
Hornbrook, Cal.: [a]					
Apr.-June	Rainbow trout	650,610	406,455		1,057,065
Mill Creek, Cal.: [a]					
Nov.-Jan.	Chinook salmon	9,547,550			9,547,550
Sparks, Nev.:					
Mar.-Apr.	Black spotted trout	171,631			171,631
	Rainbow trout	14,369			14,369
Baker Lake, Wash.:					
Entire year	Blueback salmon		4,692,573		4,692,573
	Chinook salmon		6,500		6,500
	Humpback salmon		1,425		1,425
	Silver salmon		1,670,974		1,670,974
Birdsview, Wash.: [a]					
Entire year	Chinook salmon		181,000		181,000
	Humpback salmon		1,116,500		1,116,500
	Silver salmon	2,000	5,103,000		5,105,000
	Steelhead trout	733,000	2,001,650		2,734,650
Duckabush, Wash.:					
Entire year	Dog salmon		1,856,000		1,856,000
	Humpback salmon		945,000		945,000
	Silver salmon		504,500		504,500
Elwha, Wash.: [a]					
Jan.	do		257,000		257,000

[a] For convenience in handling, transfers were made as follows:
Baird to Central Station, 20,000 chinook salmon eggs.
Hornbrook to Clackamas, 100,000 rainbow trout eggs.
Mill Creek to Nashua, 100,000 chinook salmon eggs.
Birdsview to Quilcene, 435,000 humpback salmon eggs and 450,000 silver salmon eggs; to Duckabush, 492,000 silver salmon eggs; to Central Station, 48,000 silver salmon eggs; to St. Johnsbury, 2,000 silver salmon eggs and 25,000 steelhead trout eggs; to Duluth, 75,000 steelhead trout eggs; to Bozeman, 25,000 steelhead trout eggs.
Elwha to Quilcene, 60,000 silver salmon eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912—Continued.

Station and period of operation.	Species.	Output.			Total.
		Eggs.	Fry.	Fingerlings, yearlings, and adults.	
Baker Lake, Wash.—Con.					
Illabott, Wash.:[a]					
Entire year	Chinook salmon		29,128		29,128
	Humpback salmon		106,000		106,000
	Silver salmon		1,769,465		1,769,465
	Steelhead trout		255,665		255,665
Quilcene, Wash.:					
Entire year	Dog salmon		639,000		639,000
	Humpback salmon		397,400		397,400
	Silver salmon		1,295,000		1,295,000
	Steelhead trout	47,000	27,000		74,000
Battery, Md.:					
Apr.-May	Shad		10,336,000		10,336,000
	White perch	15,000,000	452,900,000		467,900,000
	Yellow perch		270,100,000		270,100,000
Boothbay Harbor, Me.:					
Entire year	Cod		6,230,000		6,230,000
	Flatfish		490,169,000		490,169,000
	Haddock		11,316,000		11,316,000
	Lobster		179,795,000		179,795,000
Bozeman, Mont.:					
Entire year	Black spotted trout		1,063,000	611,000	1,674,000
	Brook trout		14,000	225,500	239,500
	Grayling	200,000			200,000
	Rainbow trout			91,500	91,500
	Steelhead trout			6,700	6,700
Yellowstone, Wyo.:[a]					
July-Aug	Black spotted trout	6,218,000			6,218,000
Bryans Point, Md.:[a]					
Apr.-May	Shad		80,769,000		80,769,000
	Yellow perch		191,679,595		191,679,595
Cape Vincent, N. Y.:					
Entire year	Brook trout		919,000		919,000
	Lake herring		95,000		95,000
	Lake trout		2,375,700		2,375,700
	Landlocked salmon		5,070		5,070
	Pike perch		16,700,000		16,700,000
	Rainbow trout		9,000		9,000
	Whitefish		10,400,000		10,400,000
	Yellow perch		650,000	550	650,550
Central Station, Washington, D. C.:[a]					
Entire year	Black bass			6,675	6,675
	Brook trout		24,400		24,400
	Catfish			3,395	3,395
	Chinook salmon			16,000	16,000
	Crappie			1,962	1,962
	Pike perch		7,300,000		7,300,000
	Rainbow trout		8,000		8,000
	Rock bass			4,502	4,502
	Shad		700,000		700,000
	Small mouth black bass.			4,450	4,450
	Smelt			100,650	100,650
	Sunfish			22,165	22,165
	Warmouth bass			2,346	2,346
	Whitefish		350,000		350,000
	White perch			670	670
	Yellow perch		3,900,000	65	3,900,065
Clackamas, Oreg.:					
Entire year	Brook trout		52,000		52,000
	Chinook salmon		2,910,000	750,765	3,660,765
	Rainbow trout		126,000		126,000
	Steelhead trout		184,000		184,000
Applegate, Oreg.:[a]					
Entire year	Chinook salmon		1,135,775		1,135,775
	Silver salmon		2,355,885		2,355,885
	Steelhead trout		388,100		388,100

[a] For convenience in handling, transfers were made as follows:
Illabott to Birdsview, 203,000 steelhead trout eggs.
Yellowstone to Bozeman, 3,581,000 blackspotted trout eggs; to Spearfish, 3,040,000 blackspotted trout eggs; to Leadville, 5,313,000 blackspotted trout eggs.
Bryans Point to Central Station, 4,030,000 yellow perch eggs and 838,000 shad eggs.
Central Station to Nashua, 16,000 chinook salmon fingerlings.
Applegate to Rogue River, 627,700 steelhead trout eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912—Continued.

Station and period of operation.	Species.	Output.			Total
		Eggs.	Fry.	Fingerlings, yearlings, and adults.	
Clackamas, Oreg.—Con.					
Big White Salmon, Wash.: Dec.-Feb.	Chinook salmon		6,280,100		6,280,100
Cazadero, Oreg.: Entire year	do		353,500		353,500
	Steelhead trout		685,000	117,300	802,300
Fish Lake, Oreg.:[a] July	Rainbow trout		95,400		95,400
Little White Salmon, Wash.:[a] Entire year	Chinook salmon	8,000,000	4,463,000	655,095	13,118,095
Lower Rogue River, Oreg.:[a] Jan.-Mar.	do		3,983,200		3,983,200
Rogue River, Oreg.: Entire year	Black spotted trout		15,000		15,000
	Chinook salmon		4,455,365		4,455,365
	Rainbow trout			95,134	95,134
	Steelhead trout		748,000	177,790	925,790
Willamette, Oreg.: July-June	Shad		3,054,000		3,054,000
Cold Springs, Ga.: Entire year	Black bass		6,500	40,055	46,555
	Catfish			2,371	2,371
	Rock bass			125	125
	Sunfish			27,390	27,390
	Warmouth bass			125	125
Craig Brook, Me.:[a] Entire year	Atlantic salmon		20,872	22,711	43,583
	Brook trout		35,000	8,850	43,850
	Landlocked salmon			15	15
	Scotch sea trout			10,572	10,572
Upper Penobscot, Me.: May	Atlantic salmon		1,820,349		1,820,349
Duluth, Minn.:[a] Entire year	Brook trout			356,000	356,000
	Lake trout	350,000	6,025,000	1,930,000	8,305,000
	Landlocked salmon			2,900	2,900
	Pike perch		1,150,000		1,150,000
	Steelhead trout			95,400	95,400
	Whitefish		4,825,000		4,825,000
Edenton, N. C.: Entire year	Black bass		600	7,300	7,900
	Shad	2,623,000	78,551,000		81,174,000
Weldon, N. C.: May	Striped bass		5,356,000		5,356,000
Erwin, Tenn.:[a] Entire year	Black bass		8,000	2,450	10,450
	Brook trout			254,500	254,500
	Carp			650	650
	Catfish			450	450
	Rainbow trout			501,800	501,800
	Rock bass			11,850	11,850
	Small-mouth black bass			2,700	2,700
	Sunfish			40,100	40,100
	Yellow perch			100	100
Gloucester, Mass.:[a] Entire year	Cod		48,610,000		48,610,000
	Flatfish		273,210,000		273,210,000
	Haddock		81,390,000		81,390,000
	Lobster		18,650,000		18,650,000
	Pollock		288,420,000		288,420,000

[a] For convenience in handling, transfers were made as follows:
Fish Lake to Rogue River, 104,480 rainbow trout eggs.
Little White Salmon to Clackamas, 1,100,000 chinook salmon eggs.
Lower Rogue River to Applegate, 1,158,000 chinook salmon eggs.
Craig Brook to Upper Penobscot, 1,903,625 Atlantic salmon eggs.
Duluth to Sault Ste. Marie, 180,000 lake trout eggs; to Bozeman, 50,000 lake trout eggs.
Erwin to Wytheville, 550 sunfish fingerlings; to Cold Springs, 1,400 carp fingerlings.
Gloucester to Woods Hole, 782,000 cod eggs; 14,532,000 pollock eggs; 84,674,000 flatfish eggs; 10,686,000 haddock eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912—Continued.

Station and period of operation.	Species.	Output.			Total.
		Eggs.	Fry.	Fingerlings, yearlings, and adults.	
Green Lake, Me.:[a]					
Entire year	Brook trout	1,000	1,432,500	80,000	1,513,500
	Lake trout		40,000		40,000
	Landlocked salmon	1,000	113,000	42,675	156,675
	Smelt	27,650,000	9,575,000		37,225,000
Grand Lake Stream, Me.:[a]					
Entire year	Brook trout		3,438		3,438
	Landlocked salmon	195,000	171,454	28,112	394,566
Homer, Minn.:[a]					
Entire year	Black bass			21,075	21,075
	Brook trout		42,000		42,000
	Catfish			493	493
	Crappie			750	750
	Pike perch		4,850,000		4,850,000
	Rainbow trout		7,000		7,000
	Sunfish			5,900	5,900
	Yellow perch			375	375
Leadville, Colo.:[a]					
Entire year	Blackspotted trout			4,391,500	4,391,500
	Brook trout	580,000		1,466,950	2,046,950
	Landlocked salmon		4,900		4,900
	Rainbow trout			623,500	623,500
Grand Lake Field Station, Colo.:					
Sept	Blackspotted trout		500,000		500,000
Mammoth Spring, Ark.:[a]					
Entire year	Black bass			22,200	22,200
	Crappie			500	500
	Rock bass			2,300	2,300
	Small-mouth black bass.			36,015	36,015
	Sunfish			2,028	2,028
Helena, Ark.:					
Aug.-Oct	Black bass			16,812	16,812
	Buffalo fish			39,229	39,229
	Carp			1,550	1,550
	Catfish			33,034	33,034
	Crappie			23,891	23,891
	Drum			7,280	7,280
	Pike			115	115
	Rock bass			2,015	2,015
	Sunfish			20,712	20,712
Manchester, Iowa:[a]					
Entire year	Brook trout			1,052,250	1,052,250
	Buffalofish			121,000	121,000
	Lake trout			10	10
	Pike perch		2,800,000		2,800,000
	Rainbow trout	210,000		142,900	352,900
	Rock bass			7,550	7,550
Bellevue, Iowa:					
June-Aug	Black bass			25,335	25,335
	Buffalofish		700,000		700,000
	Carp			309,600	309,600
	Catfish			30,924	30,924
	Crappie			44,300	44,300
	Drum			1,940	1,940
	Pike			4,255	4,255
	Sunfish			40,450	40,450
	White bass			680	680
	Yellow perch			930	930

[a] For convenience in handling, transfers were made as follows:

Green Lake to Cape Vincent, 6,000 landlocked salmon eggs; to St. Johnsbury, 3,000 landlocked salmon eggs; to Leadville, 5,000 landlocked salmon eggs; to Duluth, 3,000 landlocked salmon eggs.

Grand Lake Stream to Green Lake, 200,000 landlocked salmon eggs.

Homer to North McGregor, 25 yellow perch adults; to Quincy, 2,600 sunfish fingerlings.

Leadville to Clackamas, 100,000 brook trout eggs; to Bozeman, 200,000 brook trout eggs; to Baird, 50,000 brook trout eggs; to Birdsview, 25,000 brook trout eggs.

Mammoth Spring to Tupelo, 1,250 rock bass fingerlings; to North McGregor, 1,700 small-mouth black bass fingerlings; to Meredosia, 1,000 small-mouth black bass fingerlings.

Manchester to Meredosia, 7,250 rock bass fingerlings and 10 adult lake trout; to North McGregor, 200 rainbow trout fingerlings; to Homer, 100,000 brook trout eggs and 25,000 rainbow trout eggs; to Central Station, 7,800 rainbow trout eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912—Continued.

Station and period of operation.	Species.	Output. Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Manchester, Iowa—Contd. North McGregor, Iowa: July–Aug	Black bass			32,925	32,925
	Buffalo-fish			15,000	15,000
	Carp			112,000	112,000
	Catfish			27,000	27,000
	Crappie			14,500	14,500
	Drum			2,500	2,500
	Pike			50	50
	Sunfish			3,500	3,500
	White bass			700	700
	Yellow perch			400	400
Nashua, N. H.: Entire year	Brook trout		852,000	10,500	862,500
	Chinook salmon			74,400	74,400
	Landlocked salmon			700	700
	Small-mouth black bass.		29,000		29,000
	Sunapee trout		249,753		249,753
Neosho, Mo.:[a] Entire year	Black bass			10,824	10,824
	Carp			200	200
	Crappie			7,328	7,328
	Pike perch		2,000,000		2,000,000
	Rainbow trout	53,200		259,098	312,298
	Rock bass			17,585	17,585
	Small-mouth black bass.			700	700
	Sunfish			6,820	6,820
Northville, Mich.:[a] Entire year	Brook trout		455,000	390,000	845,000
	Lake trout	3,300,000	50,000		3,350,000
	Small-mouth black bass.		187,000	55,000	242,000
Alpena, Mich.: Apr.–May	Lake trout		3,500,000		3,500,000
	Whitefish		10,000,000		10,000,000
Charlevoix, Mich.: Apr.–May	Lake trout		7,000,000		7,000,000
	Whitefish		15,000,000		15,000,000
Detroit, Mich.:[a] Entire year	Pike perch		11,000,000		11,000,000
	Whitefish	5,262,500	15,000,000		20,262,500
Sault Ste. Marie, Mich.: May	Lake trout		2,500,000		2,500,000
	Whitefish		10,000,000		10,000,000
Put-in Bay, Ohio:[a] Entire year	Lake herring		15,975,000		15,975,000
	Pike perch	119,500,000	40,700,000		160,200,000
	Whitefish	4,300,000	60,100,000		64,400,000
	Yellow perch	8,500,000			8,500,000
Quincy, Ill.: Entire year	Black bass			52,677	52,677
	Buffalo-fish		75,000		75,000
	Carp			402	402
	Catfish			110,734	110,734
	Crappie			2,672	2,672
	Pike perch		3,800,000		3,800,000
	Rock bass			5,300	5,300
	Sunfish			14,850	14,850
	White bass			120	120
	Yellow perch			3,525	3,525

[a] For convenience in handling, transfers were made as follows:

Neosho to Quincy, 5,600 rock bass fingerlings and 1,885 sunfish fingerlings; to Leadville, 156,925 rainbow trout eggs.

Northville to Green Lake, 50,000 lake trout eggs; to Cape Vincent, 2,502,000 lake trout eggs; to St. Johnsbury, 100,000 lake trout eggs; to Duluth, 180,000 lake trout eggs; to Sault Ste. Marie, 2,320,000 lake trout eggs; to Alpena, 3,500,000 lake trout eggs; to Charlevoix, 7,000,000 lake trout eggs.

Detroit to Duluth, 5,000,000 whitefish eggs; to Sault Ste. Marie, 10,000,000 whitefish eggs; to Alpena, 10,000,000 whitefish eggs; to Charlevoix, 15,000,000 whitefish eggs.

Put-in Bay to Cape Vincent, 10,000,000 whitefish eggs; to Central Station, 500,000 whitefish eggs and 3,000,000 pike perch eggs; to Neosho, 2,500,000 pike perch eggs; to Wytheville, 2,000,000 pike perch eggs; to Homer, 5,000,000 pike perch eggs; to Meredosia, 5,000,000 pike perch eggs; to Manchester, 3,000,000 pike perch eggs.

STATIONS OPERATED AND THE OUTPUT OF EACH FOR THE YEAR 1912—Continued.

Station and period of operation.	Species.	Output.			Total.
		Eggs.	Fry.	Fingerlings, yearlings, and adults.	
St. Johnsbury, Vt.:[a] Entire year	Brook trout	31,500	1,095,200	14,000	1,140,700
	Lake trout		57,000	15,000	72,000
	Landlocked salmon		2,874		2,874
	Small-mouth black bass.		14,000	1,784	15,784
	Silver salmon			39,875	39,875
	Steelhead trout	28,000			28,000
Holden, Vt.:[a] Entire year	Brook trout			171,100	171,100
	Lake trout			7,527	7,527
	Landlocked salmon			5,000	5,000
	Steelhead trout			7,000	7,000
Swanton, Vt.:[a] May	Pike perch	3,000,000	116,950,000		119,950,000
	Yellow perch		8,600,000		8,600,000
San Marcos, Tex.: Entire year	Black bass			204,884	204,884
	Crappie			21,860	21,860
	Rock bass			1,965	1,965
	Sunfish			20,975	20,975
Spearfish, S. Dak.: Entire year	Blackspotted trout			1,312,000	1,312,000
	Brook trout			636,250	636,250
	Loch Leven trout			66,300	66,300
	Rainbow trout			49,730	49,730
Tupelo, Miss.: Entire year	Black bass			6,450	6,450
	Rock bass			400	400
	Sunfish			24,200	24,200
	Warmouth bass			500	500
Rosedale, Miss.:[a] Sept.-Dec	Black bass			125	125
White Sulphur Springs,[a] W. Va.: Entire year	do			10,925	10,925
	Blackspotted trout			15,070	15,070
	Brook trout	600	51,506	424,269	476,375
	Rainbow trout			44,398	44,398
	Small-mouth black bass.		222,000	4,775	226,775
Woods Hole, Mass.:[a] Entire year	Cod		182,283,000		182,283,000
	Flatfish		202,070,000		202,070,000
	Haddock		2,447,000		2,447,000
	Lobster		3,283,000		3,283,000
	Pollock		1,950,000		1,950,000
Wytheville, Va.:[a] Entire year	Black bass		3,000	26,166	29,166
	Brook trout			191,150	191,150
	Pike perch		2,000,000		2,000,000
	Rainbow trout	280,000		475,615	755,615
	Rock bass			12,675	12,675
	Small-mouth black bass.		2,500	1,825	4,325
Yes Bay, Alaska: Entire year	Blueback salmon	2,000,000	68,335,000		70,335,000
Total[b]		229,599,960	3,427,651,176	32,292,566	3,689,543,702

[a] For convenience in handling, transfers were made as follows:
St. Johnsbury to Central Station, 25,000 brook trout eggs; to Holden, 300,000 brook trout fry and 55,860 steelhead trout eggs.
Holden to St. Johnsbury, 2,000 brook trout fingerlings.
Swanton to Cape Vincent, 25,000,000 pike perch eggs; to Central Station, 4,400,000 pike perch eggs.
Rosedale to Tupelo, 714 crappie fingerlings and 125 black bass fingerlings.
White Sulphur Springs to Craig Brook, 40 adult brook trout; to Erwin, 75,000 rainbow trout eggs.
Woods Hole to Gloucester, 15,560,000 cod eggs.
Wytheville to Erwin, 400,000 rainbow trout eggs; 100 small-mouth black bass fingerlings and 3,000 brook trout fingerlings; to Central Station, 20,000 rainbow trout eggs; to Cape Vincent, 10,000 rainbow trout eggs; to Northville, 8,500 rainbow trout fingerlings.

[b] Totals show gross output of stations, without deducting the following losses in transit: Fry, 1,544,350; fingerlings, 78,295.

LIST OF EGG-COLLECTING STATIONS, 1912.

Station.	Period of operation.	Species handled.
Arkansas:		
Des Arc	Mar. 26–Apr. 8	White bass.
Marked tree	Nov. 7–Nov. 30	Miscellaneous native fish.
Colorado:		
Cheesman Lake	Apr. 9–May 29	Rainbow trout.
Edith Lake	Oct. 14–Nov. 20	Brook trout.
Eldora Lake	Oct. 14–Nov. 10	Do.
Engelbrecht Lake	Oct. 14–Nov. 12	Do.
Hallans Lake	Nov. 7–Nov. 18	Do.
Miklich Lake	Nov. 15–Nov. 23	Do.
Musgroves Lake	Nov. 7–Nov. 18	Do.
Piney Lake	July 1–July 6	Black-spotted trout.
Seven Lakes	July 1–July 10 June 6–June 30	Do.
Georgia:		
Harris Pond	Entire year	Catfish, sunfish, and large-mouth black bass.
Maine:		
Pattons Pond	Sept. 20–Mar. 30	Landlocked salmon and brook trout.
Massachusetts:		
Boston	Oct. 1–Nov. 30 May 1–June 15	Lobster.
Chilmark	Sept. 21–Oct. 9 Apr. 26–June	Do.
Gosnold	do	Do.
Plymouth	Nov. 24–Mar. 24	Cod.
Portsmouth	Jan. 20–Mar. 1 May 1–June 25	Cod and lobster.
Rockport	Nov. 1–July 1	Cod.
Sandwich	Nov. 24–Mar. 24	Do.
Waquoit	Feb. 21–Apr. 6	Flatfish.
Michigan:		
Bay City	Apr. 17–Apr. 30	Pike perch.
Belle Isle	Oct. 23–Nov. 26	Whitefish.
Charity Island	Oct. 26–Nov. 27	Do.
Cheboygan	Oct. 22–Nov. 10	Lake trout.
Detour	Oct. 13–Nov. 17	Do.
Fairport	Oct. 27–Nov. 20	Do.
Frankfort	Oct. 22–Nov. 20	Do.
Grand Haven	Oct. 21–Nov. 20	Do.
Grand Marais	Oct. 15–Nov. 11	Do.
Grassy Island	Oct. 23–Nov. 26	Whitefish.
Keweenaw Point	Oct. 2–Oct. 31	Lake trout.
Manistique	Oct. 23–Nov. 21	Do.
Marquette	Oct. 15–Nov. 11	Do.
Monroe Piers	Nov. 1–Dec. 5 Apr. 16–May 5	Whitefish and pike perch.
Munising	Oct. 15–Nov. 11	Lake trout.
Northport	Oct. 23–Nov. 20	Do.
Ontonagon	Oct. 15–Nov. 8	Do.
Port Huron	May 1–May 24	Pike perch.
St. James	Nov. 1–Nov. 25	Lake trout.
St. Joseph	Oct. 17–Nov. 20	Do.
Minnesota:		
Clarks Bay	Nov. 3–Nov. 29	Do.
Grand Marais	Sept. 23–Dec. 6	Do.
Le Claire Point	July 1–Oct. 16 Mar. 8–June 30	Sturgeon and pike perch.
New Hampshire:		
Lake Sunapee	Sept. 1–Nov. 30	Brook and sunapee trout; landlocked salmon.
New York:		
Mud Creek	Apr. 10–May 10	Pike perch.
Three Mile Bay	November	Whitefish.
Ohio:		
Kellys Island	Nov. 12–Dec. 4	Do.
Middle Bass Island	Nov. 14–Dec. 3	Do.
North Bass	Nov. 9–Dec. 3 Apr. 19–May 5	Whitefish and pike perch.
Port Clinton	Nov. 5–Nov. 29 Apr. 17–May 4	Pike perch and yellow perch.
Toledo	Apr. 16–May 5	Pike perch.
Ontario:		
Port Lampton	May 3–May 23	Do.
Rhode Island:		
East Greenwich	Mar. 20–Apr. 2	Lobster.
Wickford	Mar. 5–Apr. 17	Flatfish.
South Dakota:		
Schmidts Lakes	Oct. 30–Dec. 20	Brook trout.
Sand Creek	Oct. 20–Jan. 15	Do.
Vermont:		
Caspian Lake	Apr. 17–June 29	Steelhead trout.
Darling Pond	Aug. 15–Dec. 5	Brook trout.
Lake Mansfield	Sept. 29–Dec. 27	Do.
Lake Mitchell	Sept. 1–Dec. 12	Do.
Washington:		
Day Creek	October–June	Silver salmon and steelhead trout.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR THE FISCAL YEAR 1912.

CATFISH.

Disposition.	Fingerlings, yearlings, and adults.	Disposition.	Fingerlings, yearlings, and adults.
Alabama:		Illinois:	
Buffalo, Hunter's pond	75	Ashkum, Kankakee River	40,375
Wilson's pond	20	Hinsdale, Salt Creek	500
Opelika, Blanchard's mill pond	24	Kankakee, Kankakee River	10,625
Halewakee Pond	20	Meredosia, Meredosia Bay	50,050
Lake Lela	75	New Burnside, Caspers New Pond	800
Lyles Lake	75	Iowa:	
Murphy's pond	20	Bellevue, Mississippi River	30,924
Odam Pond	75	North McGregor, Mississippi River	25,900
Roanoke, Sander's pond	75	Kansas:	
Shank's pond	75	Belvidere, Thompsons Creek	200
Wedowee Creek	75	Marion, South Cottonwood Creek	400
Stroud, Bermuda Pond	75	Medicine Lodge, Canyon Lake	200
Arkansas:		Maryland:	
Helena, Mississippi River	33,034	Great Falls, Potomac River	3,395
Colorado:		Nebraska:	
Cheyenne Wells, Lange's pond	300	Imperial, Frenchman River	200
Colorado Springs, Sanatorium Pond	300	Lodge Pole, Lodge Pole Creek	300
Elbert, Marshal Pond	300	Nevada:	
Grand Junction, Grand River	1,000	Winnemucca, Humboldt River	300
Greenland, Allis Reservoir	2,300	New Mexico:	
Hotchkiss, Savage Reservoir	300	Cedar Hill, McIntosh Lake	300
Georgia:		New York:	
Atlanta, Taylor's pond	100	Clayton, St. Lawrence River	900
Bethel Crossing, Baboshela Pond	50	Erieville, Erieville Reservoir	300
Boneville, Johnson's pond	15	Utica, Morris Pond	300
Wilson's pond	15	Oklahoma:	
Bremen, Copeland's pond	20	Enid, Funk's pond	250
Buena Vista, Bridge Creek Pond	100	Lookeba, Walnut Grove Lake	500
Preston's pond	100	Mill Creek, Brushy Creek	400
Chickamauga, Mashburn's pond	20	Pond Creek, Wilkens Pond	250
Ellaville, Raineys Mill Pond	100	South Carolina:	
Felton, Big Creek	25	Aiken, Hammonds Pond	40
Junction City, Moore's pond	75	Greer, Collin's pond	20
Montgomery's pond	75	Enoree River	35
Lyerly, Strange's pond	25	Neeses, Boggy Pond	20
Midland, Camp Ground Pond	12	Fogle's pond	20
Mount Hope Pond	12	Tennessee:	
Star Lake	500	Highcliff, Trammels Lake	150
Moreland, Cureton's pond	35	Rogersville, Big Creek	300
Palmetto, Richardson Pond	12	Wisconsin:	
Pomona, Bermuda Lake	100	Beaver Dam, Beaver Dam Lake	32
Senoia, Brown's pond	25	Brodhead, Sugar River	500
Morgan's pond	12	Hatley, Lost Lake	93
Tallapoosa, Tallapoosa River	50	Woodland, Rubicon River	32
Trimble, Trimble Lake	24		
Waco, Parker's pond	50	Total [a]	208,381

CARP.

Arkansas:		Missouri:	
Helena, Mississippi River	1,550	Kansas City, Missouri River	100
Georgia:		North Carolina:	
Lawrenceville, New Hope Springs Pond	200	Mocksville, Howell's pond	150
		North Wilkesboro, Brown's pond	150
Illinois:		Willow Springs, Parten's pond	150
Meredosia, Meredosia Bay	390	Oklahoma:	
Iowa:		Dill, Harrell Pond	12
Bellevue, Mississippi River	309,600		
North McGregor, Mississippi River	112,000	Total	424,402
Kansas:			
Baxter, Mosier's pond	100		

[a] Lost in transit, 20 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BUFFALO-FISH.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Arkansas:		
Helena, Mississippi River		39,229
Illinois:		
Meredosia, Meredosia Bay	75,000	
Iowa:		
Bellevue, Mississippi River	700,000	
North McGregor, Mississippi River		136,000
Total	775,000	175,229

SHAD.

Disposition.	Eggs.	Fry.
Connecticut:		
Deep River, State fish commission		600,000
District of Columbia:		
Washington, Potomac River		700,000
Georgia:		
Doctortown, Altamaha River		455,000
Savannah, Savannah River		245,000
Maryland:		
Accokeek Creek, Potomac River		5,107,000
Broad Creek, Potomac River		10,038,000
Bull Cove, Potomac River		3,029,000
Chapmans Point, Potomac River		2,455,000
Glymont, Potomac River		1,314,000
Havre de Grace, Chesapeake Bay		9,286,000
Pamunkey Creek, Potomac River		3,153,000
Piscataway Creek, Potomac River		10,275,000
Swan Creek, Potomac River		6,091,000
New Jersey:		
Mays Landing, Great Egg Harbor River		450,000
North Carolina:		
Castle Hayne, Northeast River		200,000
Comfort, Trent River		200,000
Delta, Black River		200,000
Edenton, Albemarle Sound		70,715,000
Edenton Bay	533,000	2,001,000
Faison, Goshen River		250,000
Fayetteville, Cape Fear River		200,000
North Carolina—Continued.		
Goldsboro, Neuse River		200,000
Hertford, Perquomans River		300,000
Ivanhoe, Black River		200,000
Jacksonville, New River		250,000
Newbern, Neuse River		300,000
Newport, Newport River		200,000
Pollockville, Mill Creek		200,000
Roseboro, Caharie River		250,000
Skinners Point, Albemarle Sound	2,090,000	
Tarboro, Tar River		300,000
Wallace, Northeast River		200,000
Washington, Pamlico River		250,000
Wilmington, Cape Fear River		300,000
Oregon:		
Willamette, Willamette River		2,854,000
Virginia:		
Courtland, Nottoway River		400,000
Dogue Creek, Potomac River		9,495,000
Jarratt, Nottoway River		300,000
Little Hunting Creek, Potomac River		7,923,000
Mount Vernon, Potomac River		7,180,000
Occoquan Creek, Potomac River		8,243,000
Pohick Creek, Potomac River		6,466,000
Washington:		
Ferndale, Noosack River		200,000
Total [a]	2,623,000	172,975,000

WHITEFISH.

Illinois:		
Chicago, applicant	2,500	
Michigan:		
Athens, Kinyon Lake		300,000
Lehr Lake		300,000
Lower Lake		300,000
Belle Isle, Detroit River		4,000,000
Detour, Lake Huron		3,000,000
Detroit, Detroit Aquarium	260,000	
Detroit River		8,900,000
Michigan—Continued.		
Escanaba, Lake Michigan		1,000,000
Fish Island, Lake Michigan		5,000,000
Indian River, Burt Lake		300,000
Manistique, Lake Michigan		1,750,000
Marquette, Lake Superior		3,600,000
Minden City, Lake Huron		450,000
Monroe, Lake Erie		10,000,000

[a] Lost in transit, 435,000 fry.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

WHITEFISH—Continued.

Disposition.	Eggs.	Fry.	Disposition.	Eggs.	Fry.
Michigan—Continued.			New York—Continued.		
North Point, Lake Huron		5,000,000	Grenadier Island, Lake Ontario		2,500,000
Old Mission Point, Lake Michigan		5,000,000	South Bay, Oneida Lake		350,000
Scarecrow Island, Lake Huron		4,700,000	Stony Point, Lake Ontario		600,000
Skilligallee Reef, Lake Michigan		5,000,000	Tibbitts Point, Lake Ontario		3,000,000
Whitefish Point, Lake Superior		5,000,000	Wilson Bay, Lake Ontario		3,000,000
Minnesota:			Ohio:		
Duluth, Lake Superior		100,000	Burton, Punderson Lake	2,000,000	
Grand Portage, Lake Superior		615,000	Cleveland, Lake Erie	1,300,000	
Warroad, Lake of the Woods		450,000	Isle St. George, Lake Erie		10,000,000
New Hampshire:			Kelleys Island, Lake Erie		10,000,000
West Concord, Penacook Lake		300,000	Marblehead, Lake Erie		10,000,000
New York:			Middle Bass Isle, Lake Erie		10,000,000
Battery Park, New York Aquarium	1,000,000		Port Clinton, Lake Erie		10,100,000
Fullers Bay, Lake Ontario		1,000,000	Wisconsin:		
			Madison, State fish commission	5,000,000	
			Total [a]	9,562,500	125,615,000

LAKE HERRING.

Disposition.	Fry.
New York:	
Fullers Bay, Lake Ontario	95,000
Ohio:	
Kelleys Island, Lake Erie	15,975,000
Total	16,070,000

SILVER SALMON.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New York:			
Battery Park, New York Aquarium	2,000		
Oregon:			
Applegate, Applegate Creek		2,355,885	
Vermont:			
Canaan, Averill Lake			19,875
Orleans, Lake Willoughby			20,000
Washington:			
Baker, Baker Lake		236,000	
Illabott Creek		367,081	
Skagit River		1,537,974	
Birdsview, Grandy Creek		1,750,000	
Skagit River		3,250,000	
Duckabush, Duckabush River		485,000	
Puget Sound		19,500	
Elwha, Elwha River		257,000	
Illabott, Illabott Creek		977,484	
Skagit River		424,900	
Quilcene, Big Quilcene River		1,202,000	
Little Quilcene River		93,000	
Total	2,000	12,955,824	39,875

CHINOOK SALMON.

California:			
Baird, McCloud River		7,243,325	
Brookdale, State fish commission	960,000		
Sacramento, State fish commission	71,000		
San Francisco, State fish commission	3,240,000		
Sisson, State fish commission	16,254,550		

[a] Lost in transit, 60,000 fry.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

CHINOOK SALMON—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Massachusetts:			
Wilkinsonville, Quinsigamond Lake			10,000
Michigan:			
Detroit, Detroit Aquarium	25,000		
Minnesota:			
St. Paul, State fish commission	10,000		
New Hampshire:			
Blodgett Landing, Lake Sunapee			36,000
Bristol, Newfound Lake			3,600
Laconia, State fish commission	25,000		
Lake Sunapee, Lake Sunapee			24,800
Newbury, Lake Sunapee			16,000
New York:			
Battery Park, New York Aquarium	2,000		
Tuxedo Park, applicant	10,000		
Oregon:			
Applegate, Applegate Creek		1,135,775	
Bonneville, State fish commission	8,000,000		
Cazadero, Clackamas River		353,500	
Clackamas, Clackamas River		2,710,000	750,765
Station Creek		200,000	
Lower Rogue River, Lower Rogue River		3,983,200	
Rogue River, Elk Creek		200,000	
Rogue River		600,000	
Trail, Elk Creek		400,000	
Rogue River		3,255,365	
Vermont:			
Roxbury, State fish commission	100,000		
Washington:			
Baker, Baker Lake		6,500	
Big White Salmon, Big White Salmon River		1,350,000	
Columbia River		2,308,100	
Spring Creek		2,622,000	
Birdsview, Grandy Creek		150,000	
Skagit River		31,000	
Illabott, Illabott Creek		20,000	
Skagit River		9,128	
Little White Salmon, Columbia River			451,000
Little White Salmon River		4,463,000	204,095
Total	28,697,550	31,040,893	1,496,260

BLUEBACK SALMON.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Alaska:			
Afognak, Ahuyon Creek		3,468,000	
Letnik Lake		4,270,000	10,656,700
Yes Bay, McDonald Lake		19,195,000	
Yes River		49,140,000	
Oregon:			
Bonneville, State fish commission	2,000,000		
Washington:			
Baker, Baker Lake		4,692,573	
Total	2,000,000	80,765,573	10,656,700

HUMPBACK SALMON.

Disposition.	Fry.	Fingerlings.
Alaska:		
Afognak, Litnik Lake	4,150,000	1,679,300
Washington:		
Baker, Baker Lake	1,425	
Birdsview, Grandy Creek	875,000	
Skagit River	241,500	
Duckabush, Duckabush River	945,000	
Illabott, Illabott Creek	106,000	
Quilcene, Big Quilcene River	287,400	
Little Quilcene River	50,000	
Penny Creek	60,000	
Total	6,716,325	1,679,300

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

DOG SALMON.

Disposition.	Fry.
Washington:	
Brinnon, Puget Sound	20,000
Duckabush, Duckabush River	1,825,000
Puget Sound	11,000
Quilcene, Big Quilcene River	599,000
Little Quilcene River	40,000
Total	2,495,000

STEELHEAD TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Idaho:			
Hope, Lake Pend Oreille			1,000
Priest River, Blue Lake			1,500
Ramsey, Lake Chilco			1,000
Michigan:			
Munising, applicant	25,000		
Watersmeet, Beaver Station Lake			10,000
Camps Creek			10,000
Dellies Creek			10,000
Duck Creek			10,000
Henderson Creek			10,000
Wolf Creek			10,000
Minnesota:			
Lester Park, Lester River			9,000
Palmer, Sucker River			8,000
Pike Lake, Pike Lake			8,400
St. Paul, State fish commission	100,000		
New York:			
Long Lake West, applicant	50,000		
North Dakota:			
St. John, State fish commission	200,000		
Oregon:			
Applegate, Applegate Creek		388,100	
Cazadero, Clackamas River		685,000	116,300
Clackamas, Clackamas River		184,000	
Rogue River, Elk Creek		60,000	
Rogue River		688,000	177,790
Vermont:			
Cambridge Junction, Brewster River			2,500
Hardwick, Eligo Pond			1,500
Lyndonville, State fish commission	28,000		
Manchester, Stratton Pond			3,000
Roxbury, State fish commission	30,000		
Washington:			
Anacortes, Lake Douglass		20,000	
Bellingham, Lake Whatcom	100,000		
Birdsview, Grandy Creek		1,009,650	
Mill Creek		25,000	
Phenney Creek		12,000	
Skagit River		800,000	
Voglers Lake		2,000	
Bothell, Martha Lake		10,000	
Stickney Lake		15,000	
Concrete, Everet Lake		30,000	
Cement company reservoir		10,000	
Grassmere, Cement company reservoir		18,000	
Illabott, Illabott Creek		105,665	
Skagit River		150,000	
Kirkland, Lake Kirkland		20,000	
Olympia, Des Chutes River		9,500	
Mason Lake		9,500	
Quilcene, Big Quilcene River		27,000	
Republic, La Belle Lake			1,000
Seattle, applicant	50,000		
Walla Walla, applicant	25,000		
Wilkeson, Gale Creek		10,000	
Wisconsin:			
Bayfield, State fish commission	100,000		
Spooner, Christie Lake			10,000
Wyoming:			
Sheridan, State fish commission	100,000		
Whedon Creek			3,200
Total [a]	808,000	4,288,415	404,190

[a] Lost in transit, 1,000 fry.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Arkansas:			
Hot Springs, Schelly Creek			5,000
Judsonia, Spring Pond			4,000
Sylamore, Tomahawk Creek			5,090
Turkey Creek			5,000
California:			
Baird, McCloud River	10,610	10,080	
Hornbrook, Cottonwood Creek		406,455	
Mission San Jose, Mill Creek	25,000		
Colorado:			
Allenton, Eagle River			6,000
Almont, Taylor River			10,000
Alturas, Pitt River, North Fork			3,000
Arkansas Junction, Chapman Creek			2,500
Frying Pan River			5,000
Ivanhoe Creek			2,500
Jakeman Creek			2,500
Frying Pan River, North Fork			5,000
Rocky Fork Creek			2,500
South Platte River			6,000
Aspen, Colfax Lake			3,000
Conundrum Creek			3,000
Lostman Creek			1,000
Maroon Lake			2,130
Roaring Fork River			1,704
Snow Mass Lake			5,130
Stillwater Creek			2,000
Taylor Lake			5,130
Weller Lake			3,000
Bailey, South Platte River			5,000
Basalt, Black Mountain Lake			1,704
Freiler Creek			1,278
Roaring Fork Pond			1,000
West Sopres Creek			2,000
Boulder, applicant	25,000		
Breckenridge, Carter Lake			2,130
Crystal Lake			2,130
Green Lake			2,130
Buena Vista, Chalk Creek			2,556
Buffalo, Buffalo Creek			8,000
Union Water Co.'s pond			80,000
Carr, Lone Tree Creek			5,000
Catherine, Frying Pan River			4,000
Cebolla, Cebolla Creek			4,000
Gunnison River			5,000
Cliff, South Platte River			3,950
Clyde, Colorado Springs Reservoir No. 4			14,100
Middle Beaver Creek			15,650
Creede, Applicant	200,000		
Ressel Lake			1,000
De Beque, Bull Creek Lake, No. 2			3,000
Coon Creek Reservoirs Nos. 1, 2, 3, 4			15,000
Cottonwood Lakes Nos. 3, 4, 5			9,000
Leon Creek			4,000
Mesa Lake			3,000
Never Sweat Lake			3,000
Wallace Creek			3,000
Water Dog Lake			3,000
Eldora, Lake Eldora			4,000
Estabrook, Craig Creek			5,000
Florence, South Hardscrabble Creek			2,556
Fort Collins, Cache La Poudre River, North Fork			1,000
Cache La Poudre River, South Fork			4,000
Cache La Poudre River			4,000
Laramie River			4,000
Rocky Ridge Lake			[illegible]
Fraser, Fraser River			4,000
Georgetown, Clear Lake			2,800
Cunningham Lake			2,000
Duck Lake			2,600
Hunt Lake			2,000
Murray Lake			2,000
Naylor Lake			2,600
Silver Dollar Lake			2,000
Glenwood Springs, Emerald Lakes			1,852
Grizzly Creek			4,000
Lake Glenwood			1,000
Grant, Geneva Creek			5,000
South Platte River			5,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Colorado—Continued.			
Granite, Lake Creek			3,000
McFaddens Lake			5,000
Rainbow Lake			2,130
Upper Twin Lake			2,556
Hartsel, South Platte River			5,000
Hopkins, Frying Pan River			2,556
Iola, Gunnison River			10,000
Jefferson, Jefferson Creek			3,000
Kremmling, Grand River			5,000
Pass Creek			3,000
Red Dirt Creek			3,000
Leadville, Middle Evergreen Lake			3,000
Musgroves Lakes			15,000
Littleton, Bowles Lake			4,000
Loveland, Alford Lake			4,000
Big Thompson River			5,000
Big Thompson River, Millers Fork			4,000
Lyons, Big Thompson River	50,000		
Bradford Lake			2,000
Cabin Creek			4,000
Cave Creek			4,000
Rock Creek			4,000
Middle St. Vrain Creek			4,000
North St. Vrain Creek			4,000
South St. Vrain Creek			4,000
St. Vrain River, Middle Fork			5,000
St. Vrain River, North Fork			5,000
St. Vrain River, South Fork			10,000
McAndrew, McAndrew Lake			2,000
Marble, Crystal River			2,982
Meredith, Frying Pan River			4,000
Minturn, Cross Creek			3,000
Eagle River			7,000
Echo Lakes			3,000
Two Elk Creek			2,000
Moffat, Martin's pond			1,000
Smith Reservoir			1,000
Nast, Frying Pan River			4,000
New Castle, Elk Creek			4,000
Parlins, Cochetopa Creek			7,000
Platte Canon, South Platte River			10,000
Quinns Spur, Frying Pan River, North Fork			3,000
Radium, Sheephorn Creek			4,000
Rollinsville, South Boulder River			5,000
Ruedi, Ruedi Creek			2,000
Ruedi Lake			8,556
St. Cloud, Cache La Poudre River, North Fork			4,000
Salida, Cochetopa Creek			4,000
Englands Lakes			852
Sapinero, Gunnison River			5,000
Soap Creek			4,000
Sargents, Marshall Creek			4,000
Shawnee, Deer Creek			3,000
Sloss, Frying Pan River			1,000
Snow Mass, Capitol Lakes			2,556
South Fork, Rio Grande River, South Fork			7,000
South Platte, South Platte River			5,000
South Platte River, South Fork			3,000
Steamboat Springs, Blackmer Lake			1,000
Crannell Lake			1,000
Elk River			4,000
Miller Lake			2,000
Slater Creek			4,000
Grand River			2,000
Sulphur Springs, Grand River, Williams Fork			4,000
Tennessee Pass, Long Gulch Creek			1,704
Weller, Weller Lakes			1,000
Wolcott, Eagle River			7,556
Connecticut:			
Canton, Spring Branch			2,000
East Wallingford, Overbrook Pond			1,000
New Canaan, Ripewan Creek			3,200
Silver Mine Creek			6,200
Trinity Lake			2,000
Five Mile River			4,500
Waterbury, Hop Brook			800
Mad River			800
Winsted, Farmington River and tributary			10,300

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Delaware:			
Wilmington, Brandywine River			758
District of Columbia:			
Washington, Central Station Aquarium			26
Georgia:			
Clayton, Fodders Creek			4,000
Hale's pond			1,200
Hickory Bottom Creek			4,000
Hoods Creek			4,000
Martin Creek			4,000
Pounding Mill Creek			4,000
Roaches Mill Creek			1,200
Sares Creek			4,000
Scotts Creek			4,000
Stecoah Creek			4,000
Tucklich Creek			4,000
Walnut Fork Creek			4,000
Warwoman Creek			4,000
Crandall, Mill Creek			8,000
Dillard, Rabun Lake			16,000
Pierceville, Tumbling Creek			2,400
Idaho:			
Boise, State fish commission	75,500		
Cambridge, Kingsberry Pond			500
Franklin, Handy's pond			500
Hansen, Rock Creek Pond			500
Idaho Falls, Rainbow Ponds			500
Leonia, Leibrecht's lake			2,000
Hartle's lake			1,000
Curley Creek			1,500
Lorenzo, Olsons Pond			500
Malad, Stuarts Spring Pond			250
Naples, Stampede Lake			500
Roberts, Lava Springs Ponds			1,000
Thornton, Nichols Pond			750
Troy, Reirson Pond			500
Illinois:			
Belvidere, Cress Creek			675
Mount Prospect, Reese's pond			200
Indiana:			
South Bend, Willow Creek			2,000
Iowa:			
Amana, Price Creek			1,000
Arlington, Brush Creek			800
Spring Hollow Creek			200
Bellevue, Pleasant Creek			1,000
Calmar, Anton Creek			1,200
Cresco, Iowa River			3,200
Des Moines, Lake George			300
Fairbank, Elm Pond			400
Fort Atkinson, Rogers Creek			600
Guthrie Center, Woodland Lake			400
Lansing, Cavers Spring Run			200
Clear Creek			400
Cliff Spring Pond			200
Horseshoe Creek			200
Riverside Trout Ponds			400
Thompson Run			200
Van Cooly Run			200
Logan, Woodland Pond			400
Luana, Military Road Pond			200
McIntire, Spring Creek			400
Manchester, Maquoketa River			300
Monteith, Moorhead's pond			500
North McGregor, Bloody Run			1,200
Crimmins Creek			1,600
Postville, Stone House Branch			200
Yellow River			800
Waterville, Paint Creek			2,000
Little Paint Creek			400
Waukon, Bear Hollow Creek			800
Paint Creek			2,000
Patterson Creek			1,000
Silver Creek			1,000
Village Creek			1,200
Yellow River			2,000
Kansas:			
Kirwin, Gudger's pond			216
Kingman, Crappie Lake			14,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Kentucky:			
Barbourville, Goose Creek			3,260
Harlan, Cumberland River, branches			4,890
Ida May, Kentucky River, South Fork			3,260
Whitesburg, Kentucky River, North Fork			3,260
Maine:			
Bingham, Little Chase Pond			2,000
Scarboro Beach, Massacre Pond			2,000
Maryland:			
Havre de Grace, Rock Run			1,000
Mountain Lake Park, Killins Pond			800
Oakland, Big Youghiogheny River			4,000
Massachusetts:			
Concord, Punkatasset Pond			2,000
Foxboro, Lake Neponsett			4,000
Springfield, Chicopee River			4,000
Mill Brook			2,000
Michigan:			
Bailey, Crockery Creek			2,000
Crystal Falls, Paint River			1,200
Grayling, Tillulla Lake			2,000
Indian River, Sturgeon River			2,000
Jackson, Miners Mill Pond			1,500
Ravenna, Crockery Creek			3,000
Rose Center, Buckhorn Creek			1,000
Clarks Creek			1,000
Highfield River			1,000
Walhalla, Pere Marquette River, South Branch			2,000
Wingleton, Pere Marquette River			20,000
Minnesota:			
Lanesboro, Choice Creek			3,000
Preston, Camp Creek			1,000
North Branch Creek			600
Partridge Creek			300
Root River, Middle Branch			2,000
South Branch Creek			600
Trout Run			800
Watson Creek			1,000
Wisel Creek			1,500
Rushford, Choice Creek			1,100
Enterprise Creek			1,000
Silica, Little Swan River, West Branch			2,500
Missouri:			
Allenton, Spring Creek			3,000
Arlington, Gasconade River			5,000
Brownwood, Castor River			3,900
Carl Junction, Spring River			5,000
Chilton, Current River			3,900
Clement, Establishment Creek			3,900
Cooks Station, Meramec River			3,900
Everton, Sinking Creek			5,000
Fanning, Meramec River			3,900
Harrisonville, water company's lake			3,900
Lamar, Spring River			5,000
Lebanon, Lake Ha Ha Tonka			12,000
Montier, Current River, Jacks Fork			3,775
Neosho, Little River, branch of			7,800
Newbury, Keantuck Run			2,000
Newburg, Little Piney River			5,000
Pacific, Meramec River			5,000
Pearl, Sac River			3,900
Peirce City, Shoal Creek			3,900
Rolla, Coon Creek			3,750
Yancy Lake			3,000
St. Louis, Larimores Pond			400
Applicants	3,200		
South St. Joseph, State fish commission	50,000		
Springfield, Ritters Pond			10,000
Thayer, Anderson Run			1,500
Greer Spring Creek			1,500
Turner, Jim River			3,900
Warsaw, Deer Creek			20,000
Warrensburg, Applicant	2,000		
Weaubleau, Weaubleau Creek			3,900
Zalma, Castor Creek			3,900
Montana:			
Bowdoin, Bowdoin Lake			2,500
Bowdoin Reservoir			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Montana—Continued.			
Bozeman, Bridger Creek			7,000
Columbia Falls, Fish Lake			1,200
Dillon, Rattlesnake Creek			2,500
Eureka, Anthony Lake			1,200
Frank's lake			1,600
Moran Lake			1,200
Fishtail, Spring Creek	18,000		
Fortine, Dahlberg Creek			1,600
Fortine Creek			800
Murphy Creek			400
Glendive, Chrest Pond			750
Hobson, Nicholson's pond			1,000
Perrine's pond			1,000
Joliet, Rock Creek			7,000
Lewiston, Denyes Pond			9,500
McDonald Creek, South Fork			15,500
Waite Springs Pond			750
Missoula, Miller Creek			2,500
Roberts, Tule Lake			7,000
Nebraska:			
Chadron, Chadron Creek			5,000
Little Bordeaux Creek			5,000
Crawford, White River			13,000
Gretna, White River			3,000
Scotts Bluff, Spring Creek			3,000
Valparaiso, Johnson's pond			400
Nevada:			
Ely, Pierpont Creek			800
Verdi, State fish commission	14,369		
New Hampshire:			
Dover, Green Hill Brook			1,000
Harris Brook			2,000
Mullagog Brook			2,000
Thorn Brook			1,000
Wentworth, Baker River			2,000
New Jersey:			
Elberon, Whalepond Brook			3,000
Newfoundland, Menken's pond			600
Princeton Junction, Millstone River			3,750
New Mexico:			
Virsylvia, El Rito Medio			2,000
Latir Creek			4,000
New York:			
Altamont, Bozenkill Creek			3,000
Apulia, Butternut Creek			225
Babylon, Blanchard Pond			300
Battery Park, New York aquarium	5,000		
Bay Shore, Brightwater Lakes			400
Benson Mines, Star Lake		9,000	
Callicoon, North Branch			600
Cambridge, Owl Kill Creek			1,500
Georgetown Station, Middletown Creek			2,000
Freeville, Fall Creek, tributary			4,000
Katonah, Stony Hollow Lake			3,200
Lake Placid, Copperas Pond			750
Madawaska, Quebec Brook			1,500
Oneonta, Otego Creek and tributaries			8,000
Ouleout River			5,000
Third Brook			1,000
Patterson, Croton River			4,000
Pearl River, Gardner Lake			1,600
Rome, Big Alder Creek			3,000
Point Rock Brook			3,000
Sebattis, Fatfish Pond	25,000		
Swartwood, Jackson Creek			2,000
Syracuse, Butternut Creek			600
Limestone Creek			600
Onondaga Creek			600
North Carolina:			
Addie, North Fork Creek			4,000
Andrews, Great Snowbird Creek			2,400
Asheville, Shope Creek			600
Balfour, Balfour Quarry Pond			3,200
Barnard, Big Pine Creek			1,600
Big Pine Creek, North and South Forks			500
Doe Branch, forks of			400
Walnut Creek			2,400

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
North Carolina—Continued.			
Black Mountain, Dobson Creek			6,400
Flat Creek			4,000
Little Left Fork Creek			2,400
Long Branch			2,400
Mountain Creek			4,000
Noblets Creek			7,200
Owens Creek			4,000
Pool Creek			4,800
Randolph's Branch			1,600
Rock Creek			3,200
Sugar Fork Creek			3,200
Swannanoa River, North Fork			4,800
Swannanoa River, South Fork			7,200
Brevard, Alpark Lake			2,400
Bridge Creek Lake			2,400
Buckhorn Lake			2,400
Deer Park Lake			4,200
Elk Park Pond			2,400
Bryson City, Alarka Creek			6,000
Bee Creek			3,000
Bear Pen Creek			3,000
Big Branch			3,000
Bridge Creek			3,000
Buckner Creek			8,600
Cherry Creek			2,000
Coopers Creek			3,000
Deep Creek			4,000
Deep Creek, Left Fork			3,000
Deep Creek, Right Fork			3,000
Indian Creek			3,000
Kirklands Creek			3,000
Lands Creek			2,000
Long Branch			3,000
Nettle Creek			2,000
Pole Road Creek			3,000
Rock Creek			3,000
Sawmill Creek			4,000
Carpenter, Butt's pond			1,600
Chapel Hill, Boling Creek			2,000
Cherokee, Bear Wallow Creek			4,000
Big Creek			14,000
Bradley Creek			4,000
Straight Fork Creek			4,000
Tuckaseigee River, Raven Fork			6,000
Upper Creek			4,000
Cranberry, Blevins Creek			2,250
Cranberry Creek			3,000
Dillsboro, Greens Creek			3,000
Latham Creek			2,000
Elk Park, Little Elk Creek			2,250
Hendersonville, Bane's pond			300
Big Hungry Creek			300
Clear Creek, North Fork			300
First Broad River			300
Green River			7,600
Kanuga Lake			16,300
Laurel Creek			300
Reedy Park Creek			300
Hillgirt, Cloverdale Creek			2,400
Horseshoe, Fosters Creek			1,600
Mill River			3,200
Mill River, North Fork			300
Queens Creek			1,600
Laurelton, Shelton Laurel River			12,000
Linville Falls, Linville River			9,600
Marshall, Big Laurel Creek			600
Turkey Creek			2,400
Walnut Creek			2,400
Minneapolis, Toe River			4,000
Montezuma, Chestnut Height Lake			3,000
Murphy, Owl Creek			2,000
Old Fort, Curtis Creek			4,000
Penrose, Clayton Lake			2,000
Crahle Creek			2,000
Raleigh, Batt's pond			800
Rosman, East Fork Creek			300

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
North Carolina—Continued.			
Sylva, Bens Creek			1,200
Dixons Creek			1,200
Mill Creek			2,000
Tuckaseigee River, East Fork			2,400
Tuckaseigee River, West Fork			8,000
Tryon, Pocolet Creek			6,400
Tuxedo, Beddingfield Creek			300
Bobs Creek			2,400
Cabin Creek			2,400
Green River			6,200
Rock Creek			300
Waynesville, Barnes Branch			1,000
Bradley Branch			1,000
Brier Ridge Branch			1,000
Bull Creek			1,000
Campbells Creek			1,000
Carpenter Branch			1,000
Carver Creek			1,000
Cothran Branch			1,000
Curtis Creek			1,000
Edwards Creek			1,000
Evans Branch			1,000
Fowler Creek			1,000
Gaddis Branch			1,000
Hunter Creek			1,000
Indian Creek			1,000
Jackson Branch			1,000
Janes Branch			1,000
Johnson Branch			1,000
Jonathan Creek			1,200
Ketner Creek			1,000
Longs Branch			1,000
Low Branch			1,000
Maggie Branch			1,000
Mill Creek			1,000
Mitchell Branch			1,000
Moody Branch			1,000
Old City Reservoir			800
Opossum Creek			1,000
Owens Branch			1,000
Peachtree Branch			1,000
Pigeon River, East, West, and Middle Forks			12,000
Reuben Branch			1,000
Rich Branch			1,000
Rocky Branch			1,000
Sams Branch			1,000
Setzer Branch			1,000
Smith Branch			1,000
Stingy Branch			1,000
Sugar Branch			1,000
Sugarloaf Creek			2,000
Swamp Creek			1,000
Taylor Branch			1,000
True Love Branch			1,000
Turner Branch			1,000
Turpins Branch			1,000
Wycle Fork Creek			1,000
North Dakota:			
Devils Lake, Devils Lake			330
Ohio:			
Canal Fulton, Spring Brook			1,000
Mansfield, Beverstocks Run			1,500
Colwell Lake			1,000
Dickson Lake			1,000
Dickson Run			1,000
Hagerty Run			1,500
Hannawalts Creek			2,000
Ontario Creek			1,500
Spring Mill Run			2,000
Newark, Shawnee Run			1,000
Oklahoma:			
Enid, East Park Lake			7,000
Jungle Pond			7,000
Spring Park Lake			6,000
Roff, Byrds Mill Creek			1,500

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Oregon:			
Baker City, Baldock Creek		5,000	
Grand Round Lake		5,000	
North Powder River		5,000	
Bonneville, State fish commission	100,000		
Fish Lake, Big Creek		95,400	
Gibbon, Umatilla River		6,000	
Holbrook, Forest Run		1,560	
Imbler, Crystal Spring Pond		1,500	
Noon Station, Woods Creek		4,000	
Oregon City, Abernathy Creek		10,000	
Beaver Creek		12,000	
Molalla River, North Fork		16,000	
Milk Creek		12,000	
Trout Creek		13,000	
Pendleton, McKay Creek		4,000	
Rogue River, Rogue River			95,134
Union Junction, Catherine Creek		5,000	
Spofford, Walla Walla River, South Fork		8,000	
Yamhill, Yamhill River, North Fork		5,000	
Pennsylvania:			
Cammal, Trout Run			1,000
Chambersburg, Birch Run			10,100
Carbaugh			5,000
Cold Spring Run			5,000
Falling Spring Run			5,000
Hosack Run			5,000
Pine Run			5,000
Chapman Station, Haas Pond			800
Chester, Bickley's pond			1,000
Clarendon, Arnot Creek			6,300
Tionesti Creek, East Branch			7,000
Coles Creek, Pine Creek, East and North Branches			3,600
Curry, Yellow Creek			2,000
Irwin, Howell's pond			225
Karthaus, Coal Run			500
Coal Run, Left Branch			500
Connellys Run			500
Gifford Run			1,000
Main Branch			1,000
Mosquito Creek			1,000
Panther Run			500
Twelve Mile Run			1,000
Lanesboro, Canawacta Creek			3,000
Starucca Creek			4,000
Tunkhannock Creek			5,000
Latrobe, Mill Creek			1,200
Tub Mill Creek			1,200
Lemont, Buffalo Run			1,000
Mance, Brush Creek			750
New Ringgold, Cold Run			6,000
Oak Hill, Spring Creek			800
Pittsburgh, Lake Mystery			225
Renovo, Bakers Run			2,000
Barneys Run			2,000
Benjamin Run			2,000
Big Run and branches			3,000
Boggs Run			2,000
Cooks Run			2,000
Cranberry Run			1,000
Drurys Run and branches			3,000
Fish Dam Creek and branches			2,000
Halls Run			2,000
Hyner Run and branches			2,000
Mill Run			2,000
Paddys Run and branches			3,000
Shintown Run			2,000
Young Womans Creek and branches			5,000
Reynoldsdale, Bobbs Creek, tributary of			800
Royer, Piney Creek			4,000
Sheridan, South Mountain Run			400
Shrewsbury, Deer Creek			2,000
Slate Run, Nabal Run			2,000
Stillwater, Raven Creek			3,000
Summerhill, Laurel Run			450
Tunkhannock, Marsh Creek			3,000
Sugar Hollow Run			3,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Wilkes-Barre, Leonards Creek			3,000
Windber, Clear Shade Creek			4,000
Big Shade Creek			2,400
Dark Shade Creek			4,000
Rhode Island:			
Hillsgrove, Oakwood Park Brook			1,000
South Carolina:			
Greenville, Watacoo Creek			1,600
Lawrens, Little River			8,000
Madison, Battens Creek			400
Demmons Creek			1,600
Longlos Creek			800
Rocky Branch			2,400
Spartanburg, Fairforest Creek			2,400
Walhalla, Coneross Creek, McCall Branch			1,200
Coneross Creek, Poor Mountain Branch			1,200
South Dakota:			
Buffalo Gap, Beaver Creek			5,000
Smithwick, Cox Pond			800
Tennessee:			
Austral, Ellis Creek			1,600
Lost Creek			1,600
Spring Creek			2,400
Baxter, Cone Creek			8,000
Taun Creek			2,400
Chattanooga, Lake Kelso			15,600
Tennessee River			3,600
Chuckey, Middle Creek			300
Church Hill, Hoard Creek			2,000
Lyons Creek			2,000
Elkmont, Little River, East Fork			8,000
Greenville, Camp Creek			2,000
Jennings Creek			2,400
Kingsport, Reedy Creek			4,000
Kittyton, Big Branch			2,000
South Indian Creek			5,000
Knoxville, Hale's pond			800
Wood's pond			800
Milan, Mineral Creek			4,000
Roan Mountain, Doe River			7,500
Rutledge, Manley's pond			1,600
Sevierville, Fox's pond			800
Townsend, Forge Creek			3,000
Mill Creek			3,000
Unicoi, Thomas Creek			3,000
Whitesburg, Kirkpatrick's pond			300
Wolf Creek, Bear Creek			300
Feds Fork Creek			200
Wolf Creek			400
Utah:			
Brigham, Northfield Pond			1,000
Charleston, applicant	50,000		
Heber, Wherritt's creek			950
Logan, Hensen Pond			1,000
Intermountain Trout Ponds			1,000
Koller Pond			1,000
Lowe's flowing wells			1,000
Morrell's pond			1,000
Spring Creek			2,000
Springwater Brook			1,000
Worley's pond			1,500
Marysvale, Taylor Pond			1,900
Ogden, Mill Creek, branch of			2,000
Park City, Crystal Pond			975
Dillon and Snyder Creek			975
Ontario Reservoir			975
Spring Pond			975
Payson, Spring Lake Trout Farm Pond			500
Provo, Clark's pond			1,000
Dry Creek Pond			1,000
Durrant's pond			1,000
Johnson's pond			2,000
Provo River, South Fork			2,000
Spring Dell Ponds			3,000
Vineyard Pond			1,000
Salina, Rasp Lake			2,375

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Utah—Continued.			
Salt Lake City, Mill Creek Pond			1,000
Spring Creek			3,000
Thome's pond			1,000
Trask's pond			2,000
Tremonton, Andersen's pond			1,000
Peterson's pond			1,000
Vermont:			
Bellows Falls, Saxtons River			8,000
Middlebury, New Haven River			1,500
New Haven Junction, North Pond			1,500
Plainfield, Bancroft Pond			2,000
West Salisbury, Leicester River			1,500
Middlebury River			1,500
Virginia:			
Abingdon, Honaker's pond			300
Whitetop Creek			10,000
Alexandria, Potomac River		8,000	
Altavista, Hills Creek			800
Winston's pond			400
Amherst, Buffalo River			1,000
Smileys Pond			500
Beaver Dam, Coakley's pond			1,000
Big Island, Bellemers Creek			3,000
Blair, Chestnut Creek			1,500
Chilhowie, McCready's pond			300
Crozet, Doyles Creek			500
Elgin, Hazel River		13,200	
Fairwood, Fox Creek			1,500
Helton Creek			1,000
Gladys, Seneca Creek			12,500
Lowmoor, Carnes Creek, Left Fork			600
Luray, Beaver Dam Run			500
Thorntons River			500
White Walnut Run			500
Marion, Calhouns Branch			1,200
Comers Creek			1,500
Holston River, South Fork			9,000
Meeks Branch			1,600
Rock Creek			1,500
Millboro, Thompson's mill pond			500
Newcastle, Meadow Creek			800
Otter River, Rhody Creek			1,200
Paint Bank, Potts Creek			6,000
Pembroke, Lucas Pond			100
Potts Valley Junction, Stony Creek			6,000
Rustburg, Button Creek			6,000
Rural Retreat, Cripple Creek			9,500
Killinger Creek			5,000
Newlands Creek			5,000
Saltville, Tumbling Creek			1,200
Spout Springs, Wreck Island Creek			1,500
Vienna, Berry's branch			4,000
Washington:			
Chehalis, Newaukum River, North Fork		3,000	
Newaukum River, South Fork		2,500	
Heisson, State Fish Commission	100,000		
East Clallam, Beaver Lake		6,500	
Lavista, Round Lake			1,000
McCue Siding, Douglas Creek			1,000
Pomeroy, Alpowa Creek			1,250
Deadman Creek			1,250
Pataha Creek			1,250
Winona, Palouse River			1,250
West Virginia:			
Eglon, Totten Pond			100
Fairmont, Sweet Springs Ponds			800
Hawks Nest, Mill Creek			900
Huntington, Camden Park Lake			600
Ingleside, East Pond			100
Midvale, Middle Fork River			10,000
Porterwood, Pleasant Run			800
Spring Creek, Carper's pond			200
Wisconsin:			
Alma, Pipers Valley Creek		1,000	
Amherst, Peterson's creek			1,125
Aniwa, Eau Claire River			3,000
Plover River			3,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Arcadia, Major Valley Creek			500
Barnweld, Lanpop Run			500
Moyer Creek			500
Birnamwood, Embarrass River, West Branch			2,100
Embarrass River, Middle Branch			2,100
Plover River			3,000
Blair, Beaver Creek			1,250
Black Falls River, Douglas Lake			2,500
Big Falls, Little Wolf River			1,575
Pigeon Creek			1,125
Blue Mounds, Avangs Creek			500
Camp Creek			500
Happy Hollow Creek			500
Mounds Creek			500
Spring Valley Creek			500
Walnut Hollow Creek			500
Cashton, Timber Coulee Creek			750
Chippewa Falls, Paint Creek			2,100
Tilden Mill Pond			2,400
Colfax, Mirror Lake			2,100
Crandon, Peshtigo Creek, branch of			1,500
Wolf River			3,600
Dodgeville, Edmunds Pond			500
Dorchester, Popple River			3,000
Durand, Cody Creek			1,200
Eau Galle River			3,000
Ginder Creek			900
Eagle River, Deerskin Creek			100
Elmhurst, Spring Brook			2,100
Gleason, Prairie River			1,125
Harrison, Prairie River, West Branch			500
Hixton, French Creek			900
Hixton Pond			2,250
Pigeon Creek			1,350
Trempealeau River			2,250
Independence, Elk Creek			2,000
Fox Cooley Creek		1,000	
Norway Cooley Creek		1,000	
Pine Creek		2,000	
Tamarack Creek		2,000	
La Crosse, Coon River, Northeast Branch			2,000
Lancaster, Pigeon Creek			1,000
Manitowoc, Devils River			1,000
Francis Creek			1,000
Manitowoc River			2,500
Pigeon River			1,250
Merrill, Devil Creek			1,000
Pine Creek			1,000
Midway, Holmen Mill Pond			1,500
Nashville, Spring Lake			500
Oakfield, Fond du Lac River, tributaries			1,000
Richland Center, Water Villa Branch			500
Sayner, Spring Lake			1,000
Schleisingerville, Lehner's creek			500
Stanley, North Fork River			3,300
State Line, Landing Creek			900
Tamarack Creek			1,000
Stevens Switch, Stevens Creek			1,800
Superior, State Line Creek			2,000
Tomahawk, Armstrong Creek			500
Big Pine Creek			1,000
Hay Creek			500
Viroqua, Coe's branch pond			500
Waukesha, Chamberlain Creek			1,000
Pebble Brook			1,000
Whitewater, Bluff Creek			1,000
Clover Valley Creek			1,000
Territorial Creek			1,000
Utters Creek			1,000
Wonewoc, Crossman Creek			1,250
Wyoming:			
Beulah, San Creek, Lower			8,000
Cody, Belknap Lake			1,000
Eagle Creek			1,500
Shoshone River, South Fork			2,500
Greybull, Trapper Creek			2,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

RAINBOW TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wyoming—Continued.			
Lander, Fiddlers Lake			4,800
Little Popo Agie River			4,800
Sheridan, State Fish Commission	138,000		
Thermopolis, Short Lake			1,500
Austria:			
Vienna, Austrian Government	100,000		
France:			
Aix les Thermes, French Government	25,000		
Germany:			
Hamburg, German Government	50,000		
Japan:			
Tokyo, Imperial Household Department	90,000		
Portugal:			
Villa do Conde, Portuguese Government	50,000		
Total [a]	1,208,179	660,935	2,265,612

ATLANTIC SALMON.

Maine:			
East Orland, Alamoosook Lake		20,872	22,711
Staceyville, Penobscot River		1,820,349	
Total		1,841,221	22,711

LANDLOCKED SALMON.

Colorado:			
Leadville, Twin Lakes		4,900	
Connecticut:			
Simsbury, Spring Pond			500
District of Columbia:			
Washington, Central Station Aquarium			15
Maine:			
Auburn, Lake Auburn			625
Bingham, Pierce Pond			1,000
Brewer Junction, Brewers Pond			2,000
Cherryfield, Big Tunk Pond			1,000
Dedham, Branch Pond			1,950
Green Lake		25,000	
East Machias, Gardners Lake			1,000
Ellsworth Falls, Beech Hill Pond			750
Flood's pond			625
Ellsworth, Toddy Pond		16,000	
Enfield, Cold Stream Lake			625
Farmington, Chain of Ponds			2,000
Clear Water Lake			1,625
Natinas Pond			1,000
Round Pond			1,375
T Pond			750
Foxcroft, Sebec Lake			1,250
Franklin, Donell's pond			750
Fox Pond		12,000	
Molasses Pond			875
Grand Lake Stream, Grand Lake		74,454	28,112
Grand Lake Stream		117,000	
Green Lake, Morrison's ponds		10,000	
Pattens Pond		2,000	
Greenville, Fogg Pond		10,000	
Greenville Junction, Arnold Pond			1,250
Crosby Pond			625
Horseshoe Pond			1,250
Moosehead Lake			1,500
Ingalls Siding, Cedar Lake			625
Jackman, Attean Lake		8,000	
Crocker Pond		10,000	500
Duncan Lake			500
Lake Wood		8,000	750
Kennebunk, Kennebunk Pond			100

a Lost in transit, 1,000 fry and 18,063 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LANDLOCKED SALMON—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Maine—Continued.			
Kineo, Moosehead Lake			2,500
Lamberts Lake, Lambert Lake			625
Mattawamkeag, Mattacemek Lake			625
Mosquito, Lake Moxie			3,375
Oakland, East Pond			1,500
State fish commission	75,000		
Onawa, Onawa Lake			625
Rum Pond			375
Oxford, Thompson Lake			1,000
Patten, Davis Pond			375
Readfield, Parkers Pond			625
South Paris, Concord Pond			375
Shagg Pond			375
Strong, Sweets Pond			750
Tunk Pond, Tunk Pond		12,000	1,000
Walker, Squawpan Lake			875
Wilton, Wilson Lake			625
Michigan:			
Paris, State fish commission	25,000		
Minnesota:			
St. Paul, State fish commission	10,000		
Tower, Trout Lake			2,900
New Hampshire:			
Bristol, New Found Lake			700
New York:			
Au Sable Forks, Taylor Pond			1,000
Battery Park, New York Aquarium	1,000		
Caledonia, Brandreth Lake	10,000		
Lake Delaware, Lake Delaware	20,000		
Lake George, Lake George	25,000		
Lake Mahopac, Lake Mahopac			1,000
Long Lake, Doctors Pond	15,000		
Long Lake West, South Pond		2,535	
Northville, Piseco Lake		2,535	
Vermont:			
Barton, Crystal Lake			1,500
Canaan, Little Averill Lake		2,874	
Greensboro, Caspian Lake			1,500
Roxbury, State fish commission	15,000		
Total [a]	196,000	297,298	79,152

BLACKSPOTTED TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Arizona:			
Flagstaff, Oak Creek			20,000
Phoenix, Verdi River			10,000
Colorado:			
Alma, Mill Creek			12,000
Antonio, Bosque Lake			5,000
Aspen, Anderson Lake			9,000
Arms Lake			21,000
Castle Creek			15,000
Difficult Creek			15,000
Express Creek			6,000
Fall Creek			6,000
Independence Lake			15,000
Lostman Lake			9,000
Maroon Creek			15,000
New York Lake			9,000
Taylor River			30,000
West Castle Creek			12,000
Austin, Dirty George Creek			8,000
Surface Creek			8,000
Bailey, Deer Creek			24,000
Baldwin, Ohio Creek			14,000
Pass Creek			8,000
Basalt, Frying Pan River			18,000
Kellys Lake			18,000
Snow Mass Creek			9,000
Sopris Creek			12,000

[a] Lost in transit, 250 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BLACKSPOTTED TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Colorado—Continued.			
Boulder, Beaver Park Reservoir			6,000
Brainard Lake			6,000
Jacobs Pond			1,500
Jasper Lake			6,000
Long Lake			6,000
Middle Boulder River			13,500
Mitchell Lake			6,000
North Boulder River			6,000
St. Vrain River			6,000
South Boulder Creek			7,500
Buena Vista, Chalk Creek			18,000
Cottonwood Creek			18,000
Cottonwood Lake			36,000
Harvard Lakes			30,000
Middle Cottonwood Creek			18,000
North Cottonwood Creek			12,000
Pine Creek			12,000
South Cottonwood Creek			9,000
South Cottonwood Lakes			18,000
Buffalo, Buffalo Creek			36,000
Carbondale, Cattle Creek			18,000
Cassells, South Platte River			69,000
Cebolla, Gunnison River			150,000
Cedar Creek, Gunnison River			10,000
Uncompahgre River			8,000
Cimarron, Gunnison River			10,000
Clyde, water company reservoirs			162,800
Colona, Thompson Lakes			12,000
Creede, Rio Grande			97,500
Crested Butte, Brush Creek			8,000
East River			18,000
Slate River			12,000
Curecanti, Gunnison River			20,000
De Beque, Big Creek			7,500
Buzzard Creek			15,000
Cottonwood Creek			5,000
Grove Creek			7,500
Mesa Creek			7,500
Plateau Creek			22,500
Roan Creek			20,000
Delta, Cottonwood Creek			2,000
Escalante Creek			4,000
Potter Creek			2,000
Roubideaux Creek			4,000
Del Norte, Pinos Creek			10,000
Rio Grande			30,000
Dillon, Black Creek			9,000
Lost Lake			20,000
Straight Creek			9,000
Divide, Loshbaugh's twin lakes			9,000
Eagle, Brush Creek			24,000
Edwards, Lake Creek			9,000
Empire, Clear Creek			42,000
Fairplay, Sacramento Creek			9,000
South Platte River			66,000
Tumble Creek			9,000
Twelve Mile Creek			9,000
Florence, Hardscrabble Creek			12,000
Middle St. Charles River			12,000
Fort Collins, Cache La Poudre River			35,500
Deadmans Creek			9,000
Lone Pine Creek			15,000
Roaring Creek			9,000
Frisco, Ten Mile Creek			12,000
Glaciers, Cement Creek			17,500
Spring Creek			17,500
Glenwood Springs, Grizzly Creek			12,000
Granby, Grand River		20,000	
Grand Junction, Kannah Creek			10,000
Graneros, Apache Creek			12,500
Greenhorn River			22,500
St. Charles River			22,500
Granger, Myers Creek			10,000
Granite, Lake Creek			12,000
Pine Creek			12,000
Twin Lakes Creek			9,000
Upper Twin Lake			12,000
Grant, Geneve Creek			36,000
Gunnison, Bird Lakes			5,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BLACKSPOTTED TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Colorado—Continued.			
Gypsum, Sweetwater Creek			15,000
Sweetwater Lake			27,000
Deep Creek			12,000
Gypsum Creek			27,000
Hotchkiss, Clear Fork Creek			10,000
Crystal Creek			8,000
Smiths Fork Creek			12,000
Idaho Springs, Storage Reservoir			12,000
Vance Creek			9,000
Iola, East Elk Creek			10,000
North Beaver Creek			24,000
Sun Creek			24,000
Ivanhoe, Ivanhoe Creek			25,000
Lyle Creek			10,000
Jefferson, Michigan Creek			12,000
Rock Creek			9,000
Kemmling, Albert Lake			24,000
La Jara, Knights Pond			5,000
Lake City, Gunnison River, Lake Fork			8,000
Lake George, South Platte River			45,000
Leadville, Baker Creek		15,000	
Crooked Creek		20,000	
Elk Creek		15,000	
Fraser River		10,000	
Fraser Creek		85,000	
Grand Lake		120,000	
Grand River		135,000	
Half Moon Creek			10,000
St. Louis Creek		20,000	
Stillwater Creek		15,000	
Timberline Lake			35,000
Turquoise Lake			50,000
Willow Creek		45,000	
Loveland, Big Thompson River			15,000
Buckhorn Creek			15,000
Lyons, Fall River	100,000		
Minturn, Cross Creek			12,000
Gore Creek			30,000
Moffat, Corners Creek			12,000
Monte Vista, Conejos River			10,000
Montrose, Big Cimarron River			37,000
Big Red Creek			4,000
Dry Creek			4,000
Gunnison River			37,000
Horsefly Creek			4,000
Little Cottonwood Creek			2,000
Spring Creek			4,000
Nast, Frying Pan Creek			15,000
Frying Pan River			45,000
Newett, Teeter's pond			6,000
New Castle, Divide Creek			15,000
East Elk Creek			30,000
Middle Elk Creek			17,500
Norrie, Chapmans Creek			15,000
Frying Pan River			24,000
Ouray, Lake Lenore			18,000
Pagosa Springs, Big Blanco Creek			12,500
Big Navajo River			15,000
Little Blanco Creek			10,000
Weminuche Creek			12,500
Williams Creek			12,500
Pando, Eagle River			33,000
Paonia, Gunnison River, North Fork			16,000
West Muddy Creek			10,000
Pitkin, Quartz Creek			8,000
Placerville, Tanglewood Lake			2,000
Platte Canon, South Platte River			75,000
Quinns spur, Frying Pan River, North Fork			25,000
Radium, Lone Lick Lake			25,000
Sheephorn Creek			12,000
Red Cliff, Cleveland Lake			24,000
French Lake			24,000
Homestake Creek			15,000
Ridgway, Burrow Lakes			6,000
Big Cimarron Creek, headwaters of			10,000
Rosemont, East Beaver Creek			66,000
Saderlind, Gould Creek			30,000
Sapinero, Curecanti Creek			18,000
Sapinero Creek			18,000
West Elk Creek			18,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BLACKSPOTTED TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Colorado—Continued.			
Sargents, Agate Creek			15,000
Baldy Lake			27,000
Long Branch Creek			12,000
Sellar, Frying Pan River, North Fork			15,000
Sellar Creek			12,000
Shawnee, Deer Creek			36,000
South Platte River			16,500
Silver Plume, South Clear Creek, Middle Fork			12,000
Somerset, Anthracite Creek			8,000
Coal Creek			8,000
South Fork, Alder Creek			5,000
Myers Creek			5,000
Rio Grande, South Fork			15,000
Steamboat Springs, Lake Aqua Frio			8,000
Scenero Dulce Lakes			10,000
Thomasville, Dennhardts Pond			9,000
Englebrecht's pond			120,000
Spring Creek			9,000
Woods Lake			68,000
Twin Lakes			24,000
Villa Grove, Cotton Creek			12,000
Major Creek			9,000
Wild Cherry Creek			9,000
Westcliff, Bear Lake			28,000
Goodwin Creek			12,000
Horns Creek			11,000
Whitewater, North Creek			12,000
West Creek			8,000
Yampa, Trout Creek			18,000
Yampa River			35,000
Youmans, Big Blue Creek			6,000
Little Cimarron Creek			6,000
Idaho:			
Greer, Silver Pond			8,075
Thornton, Nichols Pond			10,000
Wallace, Coeur d'Alene River, North Fork			21,197
Slate Creek			21,197
Michigan:			
Detroit, Detroit Aquarium	30,000		
Montana:			
Anaconda, State fish commission	1,443,000		
Belt, Highwood Creek			6,000
Little Belt Creek			6,000
Billings, Butcher Creek	25,000		
Bozeman, Bear Creek		20,000	
Blackwoods Pond		6,000	
Bostwick Creek		10,000	
Bridger Creek		265,000	35,000
Buffalo Horn Lake		15,000	
Corbin Lake		40,000	
Lansing Creek		10,000	
Matthews Creek		20,000	
Middle Creek		50,000	
Rocky Creek		20,000	
Sales Creek		7,000	
South Cottonwood Creek		20,000	
Spring Creek		55,000	
Spring Pond		10,000	
Squaw Creek		10,000	
Story Creek		25,000	
Weaver's pond		25,000	
Wylies Pond			25,000
Butte, applicant	528,000		
Chinook, Ross Lake			8,000
Clyde Park, Brackett Creek		20,000	
Rock Creek		20,000	
Shields River		25,000	
Gardiner, Lava Creek		100,000	
Geyser, Cottonwood Creek			10,000
Davis Creek			10,000
Lewistown, Box Elder Creek			40,000
Livingston, Swindlehurst's pond		50,000	
Philipsburg, Flint Creek		35,000	
Raynesford, Arrow Creek			8,000
Red Lodge, Rock Creek Lakes			45,000
Ryegate, Big Coulee Creek			50,000
Shelby, McLaughlin Lake			12,000
Poplar Creek Reservoir			3,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BLACKSPOTTED TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Montana—Continued.			
Townsend, Crow Creek		16,000	
Deer Creek		16,000	
Grayson Creek		18,000	
Twin Bridges, Big Hale River		30,000	
Worden, Arrow Creek			12,000
Wilsall, Baker's pond			5,000
Nebraska:			
Chadron, Bordeaux Creek			26,000
Chadron Creek			5,000
Deadhorse Creek			26,000
Indian Creek			60,000
Rushville, Larrabee Creek			2,500
Nevada:			
Carson City, State fish commission	171,631		
New Mexico:			
Buckman, Rito de los Frijoles			30,000
Capitan, Hondo River			8,000
Rio Bonito			8,000
Rio Ruidoso			8,000
Carlsbad, Lake Bujoc			4,000
Clifton House, Mills Creek			25,000
Shuree Creek			25,000
South Creek			25,000
Spring Creek			25,000
Dexter, Lake Durand			4,000
Domingo, Media Dia River			6,000
Glorieta, Pecos River			54,000
Las Vegas, Gallinas River			38,000
Mountain Air, Barranca Creek			4,000
Laguna Rendija			4,000
Pecos, Irving Springs			4,000
Questa, Caberesto Creek			7,500
Raton, Cimman Point Creek			15,000
Rayolo River			20,000
Sugarite Creek			35,000
Ribera, Pecos River			14,000
Rowe, Bull Creek			10,000
Cow Creek			15,000
Pecos River			37,000
Santa Fe, Frijoles River			6,000
Gallinas River			14,000
Pecos River, Upper			14,000
Rio Tesuque Creek			20,000
Santa Fe Creek			10,000
Taiban, Taiban Creek			2,000
Tularosa, Rio Ruidoso			18,000
Ute Park, American Creek			20,000
Rio Grande			76,000
Ute Reservoir Creek			10,000
Wagon Mound, Tison Springs			2,000
Willard, Railroad Reservoir			2,000
New York:			
Saranac Inn, State fish commission	40,000		
Oregon:			
Rogue River, Rogue River		15,000	
Salem, State fish commission	652,000		
South Dakota:			
Custer, French Creek			40,000
Squaw Creek			40,000
Elk Horn, Rapid Creek			40,000
Elmore, Spearfish Creek			75,000
Fruitdale, Stearns Pond			7,500
Galena, Elk River			60,000
Hill City, Spring Creek			8,000
Iron Creek, Spearfish Creek			75,000
Mystic, Castle Creek			60,000
Nahant, Rapid Creek			50,000
Nemo, Box Elder Creek			60,000
Pringle, Beaver Creek			20,000
Rapid City, Box Elder Creek			60,000
Rapid Creek			60,000
Rochford, Castle Creek			80,000
Gimlet Creek			20,000
Rapid Creek			120,000
Silver Creek			6,000
Spearfish, Chicken Creek			2,000
Crow Creek			2,000
Johnson Creek			15,000
Spearfish Creek			250,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BLACKSPOTTED TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Utah:			
Colton, Elmer's pond			8,000
Virginia:			
Clifton Forge, Smith Creek			50
Washington:			
Garfield, Palouse River			30,281
Seattle, applicant	50,000		
Tacoma, Little Marshall River			14,400
Silver Lake			28,800
West Virginia:			
Marlington, Barkley Run			7,500
Knapps Creek			7,520
Wyoming:			
Beulah, Finch Run			4,000
Sand Creek			12,000
Shepard Creek, East Branch			20,000
Cody, Ishawood Creek			18,000
Jones Creek			15,000
Middle Creek			21,000
North Fork Creek			39,000
Greybull, Shell Creek Lakes			60,000
Ranchester, Soldier Creek		65,000	
Saratoga, North Platte River			6,000
Sheridan, Dome Lake		35,000	
North Piney River		25,000	
State fish commission	2,000,000		
Thermopolis, Red Creek			15,000
Yellowstone National Park, Boat House Creek	600,000		
Cub Creek	100,000		
Natural Bridge Creek	350,000		
Second Creek	300,000		
Total[a]	6,389,631	1,578,000	6,285,820

LOCH LEVEN TROUT.

Disposition.	Fingerlings, yearlings, and adults.
South Dakota:	
Savoy, Little Spearfish Creek	66,300

LAKE TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
District of Columbia:			
Washington, Aquarium			10
Maine:			
Farmington, Clearwater Pond		15,000	
Locke's Mills, South Pond		10,000	
Perry, Boyden's Lake		15,000	
Unity, Unity Pond			1,500
Massachusetts:			
Clinton, Spectacle Lake		25,000	
Greenwich, Quabbin Lake		15,000	
Michigan:			
Atwoods Reef, Lake Michigan		700,000	
Beechwood, Golden Lake			40,000
Big Rock Reef, Lake Michigan		700,000	
Cathead Point, Lake Michigan		700,000	
Charlevoix Reef, Lake Michigan		1,400,000	
Detour, Lake Huron		1,000,000	

[a] Lost in transit, 43,750 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LAKE TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Michigan—Continued.			
Detroit, State fish commission	3,000,000		
Escanaba, Lake Michigan		150,000	
Fishermans Island, Lake Michigan		700,000	
Fish Island, Lake Superior		440,000	
Grand Marais, Lake Superior		1,200,000	
Irishmans Reef, Lake Michigan		700,000	
Isle Royale, Lake Superior		400,000	1,240,000
Long Point, Lake Superior		240,000	
McCargoes Cove, Lake Superior		400,000	
Manistique, Lake Michigan		150,000	
Marquette, Lake Superior		700,000	
Munising, Lake Superior		700,000	
North Point, Lake Huron		1,822,000	
North Point Reef, Lake Michigan		700,000	
Norwood Reef, Lake Michigan		700,000	
Nine Mile Point, Lake Michigan		700,000	
Ontonagon, Lake Superior		700,000	
Peacock, Little Bass Lake		30,000	
Scarecrow Island, Lake Huron		1,678,000	
Union Lake, Union Lake		20,000	
Minnesota:			
Beaver Bay, Lake Superior		120,000	120,000
Clarks Bay, Lake Superior		480,000	
Duluth, Lake Superior			40,000
Grand Marais, Lake Superior		725,000	310,000
Grand Portage, Lake Superior		360,000	40,000
Lincoln, Lake Alexander			40,000
St. Paul, State fish commission	250,000		
Stannard Rock, Lake Superior		240,000	
New Jersey:			
Boonton, Boonton Reservoir		30,000	
New York:			
Caledonia, State fish commission	50,000		
Charity Shoals, Lake Ontario		420,000	
Forestport, Lake Honnedaga			900
Fox Island, Lake Ontario		405,000	
Fuller Bay, Lake Ontario		193,700	
Grenadier Island, Lake Ontario		550,000	
Hammondsport, Lake Keuka		75,000	
Hayes Point, Lake Ontario		125,000	
Long Lake West, Catlin Lake			1,150
Loon Pond	50,000		
Little Grenadier Island, Lake Ontario		140,000	
Northville, Lake Piseco		50,000	
Northville, Sacandaga Lake		50,000	
Stony Point, Lake Ontario		125,000	
Willsboro, Warm Pond		25,000	
Wilson Bay, Lake Ontario		122,000	
Pennsylvania:			
Pleasant Mount, State fish commission	100,000		
Towanda, Lake Weesunking		25,000	
Utah:			
Salt Lake City, State fish commission	50,000		
Vermont:			
Barton, Baker Pond			1,000
Crystal Lake			1,500
Silver Lake		12,000	
Canaan, Big Averill Lake		20,000	
Island Pond, Echo Pond			15,000
Newport, Seymour Lake			1,300
Orleans, Willoughby Lake		25,000	
Roxbury, State fish commission	100,000		
Wisconsin:			
Eagle River, Anvil Lake			11,500
Loon Lake			14,500
Pine Island Lake			14,500
Sand Island, Lake Superior		520,000	
Iron River, Spring Lake			25,000
State Line, Black Oak Lake			30,000
Wyoming:			
Sheridan, State fish commission	50,000		
Total[a]	3,650,000	21,547,700	1,950,660

[a] Lost in transit, 1,877 fingerlings.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Arizona:			
Flagstaff, Mountain Creek			500
Winkleman, Gila River			500
California:			
Bridgeport, Walker River and tributaries			16,000
East Auburn, American River			15,500
Red Bluff, Antelope Creek			15,500
Colorado:			
Almont, Taylor River			10,000
Alturas, Pitt River, North Fork			2,000
Baldwin, Beckwith Lake			20,000
Black Hawk, Dory Lake			35,000
Cimarron, Gunnison River			25,000
Johnson Park Lake			15,000
Van Lake			20,000
Denver, State fish commission	25,000		
Doyleville, Tomichi Creek			35,000
Eldora, Lake Kanawha			20,000
Fraser, St. Louis Creek			20,000
Grant, Duck Creek			10,000
Duck Lake			25,000
Falls Creek			15,000
Geneva Creek			20,000
Three Mile Creek			10,000
Idaho Springs, Chicago Creek			25,000
Chiens Lake			10,000
Fall River			20,000
Idaho Springs Storage Reservoir			15,000
Lake Edith			90,000
Sherwin Lake			5,000
Silver Lake			20,000
Iola, Gunnison River			10,000
Rainbow Lake			15,000
Jefferson, Lost Park Creek			30,000
Lake City, San Christobal Lake			58,000
Leadville, Musgroves Lake			270,000
Sherwick's lake			1,000
Lyons, Cabin Creek			10,000
Cave Creek			10,000
Rock Creek			10,000
St. Vrain River, Middle Fork			10,000
St. Vrain River, North Fork			10,000
St. Vrain River, South Fork			10,000
McAndrew, McAndrew Lake			150
Malta, applicant	25,000		
Marshall, South Boulder Creek			375
Moffat, East Twin Lake			5,000
Oak Creek, Morrison Creek			25,000
Pando, Eagle River			250
Parlin, Chaney Lake			15,000
Cochetopa Creek			7,500
Lampshire Lake			15,000
Parshall, Cold Spring Run			4,000
Grand River, Williams Fork			35,000
Pine Grove, Elk Creek, South Fork			20,000
Pitkin, Middle Creek			12,000
Quartz Creek, South Fork			10,000
Sapinero, Soap Creek			15,000
West Elk Creek			30,000
Sargent, Tomichi River			20,000
Steamboat Springs, Big Creek			15,000
Elk Head Creek			15,000
Elk River, South Fork			15,000
Fish Creek			15,000
Fredrum Lakes			55,000
Mad Creek, North Fork			15,000
Mad Creek, South Fork			15,000
Ranger Lakes			20,000
Service Creek			15,000
Snake River, Middle Fork			20,000
Willow Creek			20,000
Yampa River			35,000
Tabernash, Junction Lake			8,000
Vasquez, Vasquez Creek			12,000
Youmans, Big Blue Creek			20,000
Elk Creek			6,000
Little Cimarron Creek			20,000
Little Cimarron River East Fork			6,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Connecticut:			
Bridgeport, Far Mill River		6,000	
Canaan, Blackberry River		20,000	
Konkapot River		30,000	
Essex, Falls River		8,000	
Nettleton's Brook		6,000	
East Hampton, Dickinson Creek		6,000	
East Haddam, Eight Mile River		12,000	
Roaring Brook		8,000	
Granby, Bissels Brook		10,000	
Greenwich, Byram River		8,000	
Lakeville, Burton Brook		10,000	400
Cleveland Brook			400
Moose Brook			400
Washinee Brook			400
Leonards Bridge, Pease Brook		5,000	
Manchester, Roaring Brook		15,000	
Mount Carmel, Mill River			900
New Canaan, Mill River		20,000	
Norwich, Broad Brook		5,000	
Choat Brook		8,000	
Portland, Hurlbut Brook		6,000	
Roxbury, Jacks Brook			600
Sound Beach, applicant	2,500		
Tariffville, Mitchelson Pond			400
Thomaston, Lead Mine Creek			600
Pine Cobble Brook			600
West Branch			600
Waterbury, Hop Brook		10,000	
Mad River		15,000	
Waterville, Hancock Brook			900
Wilton, Comstock Brook		8,000	
Windsor, State fish commission	25,000		
Delaware:			
Wilmington, Red Clay Creek			1,516
District of Columbia:			
Washington, Central Station Aquarium			150
Georgia:			
Dillard, Rabun Lake			15,000
Clayton, Earl Creek			3,000
Long Branch			3,000
Mountain City, Bee Branch			3,000
Idaho:			
Boise, Spring Creek			750
Cambridge, Pine Creek			2,000
Hailey, Deer Creek			2,000
Idaho Falls, Krafts Hatchery Ponds			750
Malad, Caraboo Pond			500
Daniels Run			1,000
Williams Pond			750
Mullen, Deadman Creek			750
South Fork Creek			750
Willow Creek			750
Naples, Fall Brook			1,250
Roberts, Raymond's pond			2,000
St. Anthony, Spring Lake			3,000
Springfield, Tanners Lakes			750
Indiana:			
South Bend, Ullery Creek			2,000
Iowa:			
Atlantic, Bregning Soe Pond			500
Manchester, Spring Branch			3,500
Osage, Spring Park Creek			450
Postville, Livingood Branch			3,000
Maine:			
Augusta, Lake Cobbosseecontee			18,000
Bar Harbor, Eagle Lake		15,000	
Harrison's pond			50
Biddeford, Boiling Spring Brook		2,500	
Dyer Brook		5,000	
Hill Brook		7,500	
Kay Brook		5,000	
Little Milliken Brook		5,000	
Murch Brook		5,000	
Red Water Brook		5,000	
Ricker Brook		5,000	
Running Brook		5,000	
Silley Brook		5,000	
Tapley Brook		5,000	

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Maine—Continued.			
Bigelow, Alder Creek		4,000	
Big Jim Pond		4,000	
Blakeslee Lake		4,000	
Carner Pond		4,000	
Jim Pond		6,000	
Joe Pocum Pond		6,000	
Long Lake		4,000	
Round Mountain Lake		4,000	
Rush Pond		6,000	
Spring Lake		6,000	
Bingham, Carry Pond		15,000	
Pleasant Pond		30,000	
Bradbury, Locke Brook		5,000	
Red Brook		5,000	
Wales Pond			800
Bridgton, Bickford Brook		5,000	
Shell Pond Brook		5,000	
Bridgton Junction, Crystal Lake		15,000	
Bryant Pond, Lake Christopher		15,000	
Bucksport, Pattens Pond		10,000	
Dedham, Branch Pond		50,000	
Mann's brook			24,000
Phillips Lake		50,000	
East Machias, Rocky Lake		15,000	
East Orland, Billings Pond		10,000	
Meadow Brook		5,000	
Woods Pond		10,000	
East Peru, Silver Lake		12,000	
Ellsworth, Pattens Pond		60,000	800
Toddy Pond		15,000	
Ellsworth Falls, Beech Hill Pond		15,000	
Branch Run		15,000	
Farmington, Beaver Pond		10,000	
Chain of Ponds			1,000
Dead River, North Branch		7,500	
Indian Creek		7,500	
Long Pond		10,000	
Shallow Pond		7,500	
Franklin, Molasses Pond		25,000	
Fryeburg, Cold River		10,000	
Hanscom Brook		7,500	
Little Saco Creek		5,000	
Grand Lake Stream, Grand Lake Stream		3,438	
Greenville, Horseshoe Pond		10,000	
Lower Hathorn Pond		10,000	
Massachusetts Pond		10,000	
Mud Pond		10,000	
Otter Pond		10,000	
Pleasant River, West Branch		12,500	
Hartland, Lemon Creek		6,000	
Holden, Hopkins Pond		15,000	
Holeb, Holeb Lake		8,000	
Jackman, Attean Lake		6,000	10,000
Cold Stream Pond		6,000	
Crocker Pond		6,000	
Hatchery Brook		2,000	
Heald Pond		6,000	
Jones Pond		6,000	
Lake Parlin		6,000	
Lake Wood		6,000	
Little Big Wood Pond		6,000	
Rancour Pond		6,000	
Spencer Lake		8,000	
Williams Brook		4,000	
Kennebunk, Kennebunk Pond		20,000	
Little River		12,500	
Murphy Brook		5,000	
Kineo, Moosehead Lake		20,000	
Kingfield, Tufts Pond		6,000	
Kingman, Pleasant Lake		20,000	
Knox Station, St. Georges Lake		12,000	
Lincoln, Brown Brook		7,500	
Mackamp, Moose River			10,000
Mapleton, Squawpan Lake		9,000	
Marrs Station, Indian Pond		15,000	
Monmouth, Buker Lake		14,000	
Jimmy Pond		14,000	

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Maine—Continued.			
Mosquito, State fish commission	100,000		
Oakland, Messalonskee Lake		15,000	
Oldtown, Birch Creek			12,000
Otis, Green Lake		200,000	
Patten, Lower Shin Pond		12,000	
Spring Pond		10,000	
Phillips, Carlton Pond		8,000	
Sandy River Pond		8,000	
Portland, Fort McKinley Pond		12,500	
Presque Isle, Arnold Brook		3,000	
Echo Lake		7,500	
Presque Isle Creek		7,500	
Rockland, Canaan Lake		20,000	
Rumford Falls, Howard Lake		30,000	
Schoodic, Schoodic Lake		12,000	
Searsport, Swan Lake		15,000	
Skinner, Bog Brook		4,000	
Deer Pond		6,000	
Lowell Pond		4,000	
South Paris, Concord River		10,000	
Twenty Mile River		10,000	
Spear Creek		7,500	
Washburn Pond		10,000	
Steep Falls, Horn Pond		12,500	
Tunk Pond, Tunk Pond		15,000	
Waldoboro, Back Brook		5,000	
Cooneys Brook		6,000	
West Bethel, Mains Pond		5,000	
Wilton, Webbs Pond		32,000	
Maryland:			
Baltimore, Beaver Dam Creek		9,150	
Big Pool, Lanes Run			150
Bloomington, Elk Lick Run			800
Folly Run			800
Boyds, Little Seneca Creek and tributaries			1,500
Cumberland, Rocky Gap Creek			1,600
Deer Park, Little Youghiogheny River			1,200
Ellicott City, Middle Patuxent River		15,250	
Gaithersburg, Coxton Creek			100
Magruder Branch			200
Garrison, Green Spring Valley Branch			200
Hagerstown, Marsh Run			200
Hancock, Cohills Run			800
Manns Run			800
Harkins, Falling Branch Run			100
Halfway, Mill Springs Run			150
Midland Junction, Elk Lick Run			800
Mountain Lake Park, Bakers Run			400
Comegys Run			800
Garretts Run			400
Kings Run			800
Laurel Run			1,200
Oakland, Broad Ford Run			400
Deep Creek			1,200
Dunkard Lick Run			400
Marsh Run			400
Pond Run			400
Shelbysport, Cove Run			800
Mill Run			1,600
Smithsburg, Fogle Run			150
Long Meadow Creek			200
Silver Falls Creek			100
Swanton, North Glade Creek			400
Pleasant Valley Run			1,600
Timonium, Mayfair Creek			2,500
White Hall, Little Creek			200
Massachusetts:			
Athol Centre, Millers River			3,000
Concord Junction, Wrights Creek			1,000
Dalton, Shaw Brook			1,000
East Weymouth, Birch Pond			1,000
Fall River, Bread and Cheese Brook			1,500
Shingle Island River			2,000
Gardner, Templeton Brook			500
Gloucester, Latonia Pond			150
Great Barrington, Harmon Brook			500

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Massachusetts—Continued.			
Greenfield, Fisks Pond			1,500
Gulf Brook			1,000
Stone Brook			400
Lancaster, Hillside Pond		5,000	
Leominster, Lines Brook			3,500
North Dana, Meadow Brook Pond			300
Silver Brook Pond		20,000	
Swift River, East Branch			500
Northampton, Ahearn Brook		5,000	
Crosby Brook			1,000
Howards Pond			1,000
Otter River, Bailey Brook		8,000	
Poor Farm Brook		6,000	
Underwood Pond		30,000	
Pittsfield, Sackett Brook		5,000	
Schoolhouse Brook		6,000	
Secum Brook		6,000	
Shelburne Falls, Ford Pond			500
Springfield, Great Brook			2,000
Mill River, South Branch		15,000	
North Branch			2,000
Stockbridge, Konkapot Brook		10,000	
Waltham, Pantry Brook		6,000	
Westfield, Big Powder Mill Brook			1,000
Jacks Brook			1,000
Little River		30,000	2,500
Powder Mill Brook			1,000
Sandy Mill Brook			1,000
Whately, Mill River		6,000	
Michigan:			
Baldwin, Baldwin Creek and branches		25,000	8,000
Battle Creek, Helmer Brook		12,000	
Pine Creek		12,000	
Seven Mile Creek		16,000	
Belding, Black Creek			6,000
Bellaire, Shanty and Cold Creek			12,000
Betely, Pere Marquette River			10,000
Black River, Silver Creek			20,000
Branch, Weldon Creek		20,000	
Central Lake, Central Lake and tributaries			12,000
Chase, Pere Marquette River		20,000	
Clare, Clear Creek			800
Five Lake Creek			800
Holstend Creek			400
Lowery Creek			400
McEwan Creek			800
McKinley Creek			800
Tobacco River and branches		20,000	
Copper City, Hills Creek			6,000
Delaware, Trap Rock River			3,000
East Tawas, Silver Creek			30,000
Evart, Muskegon River		20,000	
Farwell, Chippewa River and branches		25,000	
Frederic, Au Sable River			50,000
Gaylord, Au Sable River, North Branch			45,000
Grayling, Tillulla Lake			5,000
Hale, Hale Creek			10,000
Hillman, Pike Creek			20,000
Indian River, Big Pigeon Creek		25,000	
Little Pigeon Creek		10,000	
Little Sturgeon River		15,000	
Interlochen, Betsey River			12,000
Ironwood, Jones Brook			3,000
Ishpeming, Black River			5,000
Escanaba River and tributaries			16,000
Greens Creek			6,000
West Branch River			6,000
Isle Royale, Tobens Harbor			8,000
Jackson, Dearing Creek			400
Sandstone Creek			800
Kaleva, Cedar Creek			8,000
La Rocque, Quinn Creek			6,000
Mandan, Montreal River			8,000
Mosquito Creek			4,000
White Birch River			4,000

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Michigan—Continued.			
Mayfield, Boardman River			12,000
Nirvana, Blood Creek		20,000	
Sanborn Creek		20,000	
Oden, Goodrich Creek			8,000
Minnehaha Creek			10,000
Ojibway, Gratiot River			6,000
Peacock, Sable River and branches			12,000
Pellston, Maple River			30,000
Phoenix, Horseshoe Pond			3,000
Jacobs Creek			3,000
Presque Isle, Swan Creek			20,000
Rose City, Houghton Creek			10,000
Thompsonville, Little Betsey River			8,000
Wellington, Balsam Brook			300
Beaver Creek			3,000
Birch Creek			600
Clover Creek			3,600
Foleys Creek			300
Honeymoon Creek			3,000
Little Spring Creek			300
Mays Brook			300
Nine Mile Creek			300
Pigeon Creek			3,000
Slippery Elm Creek			300
Sutherland Creek			600
Wellington, Weazel Creek			300
Windiate Park, Leaches Creek			2,000
Wingleton, Bowman Creek			2,000
Dannaher Creek			8,000
Spring Creek			400
Tank Creek			400
Sweetwater Creek			8,000
Minnesota:			
Caledonia, Bear Creek			250
Crooked Creek			9,000
Crystal Creek			6,000
Dexter Creek			6,000
East Beaver Creek			9,000
Eastcott Creek			3,000
Messerall Creek			250
Riceford Creek			6,250
South Fork Lake			6,000
South Winnebago Creek			250
West Beaver Creek			6,000
Wildcat Creek			6,000
Winnebago Creek			9,000
Detroit, Sucker Creek			3,000
Duluth, Eaton Creek, South Branch			3,000
Ely, Long Lake			8,000
Freeburg, Badger Creek			6,000
Irish Creek			3,000
Thompson Creek			6,000
Harmony, Big Spring Creek			4,000
Camp Creek			4,000
Gregorson Spring Creek			4,000
Highland, Gooseberry River, Left Branch			8,000
Hokah, Ormsby Creek			6,000
Thompson Creek			6,000
Jenkins, Pine River			8,000
Knife River, Baptism River			5,000
Beaver River			5,000
Gooseberry River			5,000
Knife River			5,000
Knife River, East Branch			5,000
Knife River, West Branch			5,000
Manitou River			5,000
Split Rock River			5,000
Stewart River			5,000
Lamoille, Beach Valley Creek		1,000	
Big Trout Creek		1,000	
Dakota Valley Creek		1,000	
Little Trout Creek		1,000	
Murray Valley Creek		1,000	
Pickwick Valley Creek		1,000	
Pine Creek		2,000	
Richmond Valley Creek		1,000	

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Minnesota—Continued.			
Lanesboro, Amherst Creek			250
Boyun Creek			250
Brake Creek			250
Camp Creek			250
Dammen Creek			250
Dusbee Creek			250
Jensen Creek			250
Mork Creek			250
Nepstead Creek			250
Pilot Mound Creek			250
Riceford Creek			250
Scotland Creek			250
Shattuck Spring Creek			250
Sletwold Creek			250
Torgerson Creek			500
Trout Run			250
Watson Creek			250
Wisel Creek			250
Lewiston, Hemingway Creek			800
Pine Creek			800
Little Falls, Hillman Creek			5,000
Nokasippi River			5,000
Skunk Creek			5,000
Swan River			5,000
Minnesota City, Bear Valley Creek			800
Chimney Rock Creek			800
Deerings Valley Creek			800
Enterprise Creek			800
Ferguson Creek			800
Rollingstone Creek			1,600
Rupprechts Valley Creek			1,600
Rush Creek			1,600
Speltz Valley Creek			800
Straight Valley Creek			800
Whitewater River, South Branch			1,600
Plainview, Beaver Creek			250
East Indian Creek			250
Funks Pond			250
Logan Creek			250
Long Creek			250
Middle Creek			250
West Indian Creek			250
Whitewater River, North Branch			250
Preston, Partridge Creek			99,000
Willow Creek			700
Red Wing, Belle Creek			750
Bullard Creek			500
Clear Creek			250
German Creek			250
Hay Creek			750
Wells Creek			750
River Junction, Thompsons Creek			750
Rochester, Badger Run		2,000	2,000
Bear Creek		3,000	500
Chester Creek		2,000	
Dux Creek		2,000	
Mayo Creek			1,250
Silver Creek		2,000	
Spring Brook		2,000	
Willow Creek		2,000	
Wood Brook		1,000	
Rollins, Bates Creek			5,000
Pine Creek			6,000
Twin Creek			5,000
St. Charles, Campbells Branch			800
Carters Run			1,600
Crows Creek			1,600
Demuths Creek			800
Drakes Creek			800
Ferguson Creek			1,600
Hemingway Creek			800
Holme Spring Creek			800
Holts Creek			800
Logan Branch			1,600
Nichols Creek			1,600
O'Meara Creek			800
Pettis Creek			800
Pine Creek			1,600

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Minnesota—Continued.			
St. Charles, Quincy Creek			1,600
Rush Creek			2,400
Trout Run			1,600
Troy Creek			2,400
Whitewater River			1,600
Whitewater River, Middle Branch			1,600
Whitewater River, North Branch			800
Whitewater River, South Branch			2,400
Schauff Lake Station, Knife River, East Branch			5,000
Little Gooseberry Creek			8,000
Split Rock River			8,000
Spring Valley, Ætna Creek			3,250
Bayans Creek			1,500
Cold Spring Run			3,000
Farmers Creek			1,500
Fast Creek			1,500
Hamilton Creek			1,500
Hutchinson Creek			3,000
Kingsley Creek			3,000
Little Mahood Creek			1,500
Mahood Creek			3,250
Middle Branch			3,000
North Branch			3,000
North Jordan Creek			3,000
Root River, Middle Branch			250
Root River, North Branch			250
Root River, South Branch			250
Seven Spring Run			1,500
Simons Creek			1,500
South Branch			3,000
South Jordan Creek			3,000
Spring Valley Creek			6,250
Two Harbors, Crow Creek			5,000
Knife River, Northeast Branch			6,000
Little Knife River			4,000
Little Stewart River			6,000
Silver Creek			8,000
Stewart River			6,000
Whalan, Gribin Creek			250
Winona, Abell Valley Creek		1,000	
Cedar Creek		2,000	
Corey Valley Creek		1,000	
East Burns Valley Creek		1,000	
Gilmore Valley Creek		2,000	
Harvey Valley Creek		1,000	
Hicks Valley Creek		1,000	
Laufenburger Valley Creek		1,000	
Middle Valley Creek		1,000	
Morrison Valley Creek		1,000	
Pleasant Valley Creek		2,000	
West Burns Valley Creek		1,000	
Wiscoy Creek		2,000	
Wrenshall, Alder Creek		4,000	
Missouri:			
Floyd, Applicant	30,000		
South St. Joseph, State fish commission	30,000		
Montana:			
Bearmouth, Ten Mile Creek			1,250
Belgrade, Benhardt Creek			5,000
Cowan Creek			6,000
Reese Creek			8,000
Smith Creek			8,000
Storey Creek			6,000
Belt, Cora Creek			1,200
McCord Creek			1,000
Sawmill Creek			1,000
Big Sandy, Big Sandy Creek			2,250
Boulder, Elkhorn Creek			1,250
Bozeman, Bridger Creek		11,000	8,000
Camps Creek			8,000
East Gallatin River			3,000
Fish Creek			6,000
Corwin Springs, Harriette Lake			1,000
Eureka, Glen Lake			750
Murray Lake			1,500
Peltiers Pond			1,000
Spring Lake			1,250
Spring Creek			750

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Montana—Continued.			
Fortine, Stahl's lake			500
Gardiner, Glen Creek			10,000
Hamilton, Mill Creek			1,750
Harlowton, Hoply Creek			8,000
Hobson, Henry Lake			750
Hollidays Crossing, Spring Creek			1,000
Kalispell, Dingman's pond			750
Lennep, Cottonwood River, East Fork			8,000
Lewistown, Big Spring Creek			3,750
Corbin Creek			800
Flat Willow Creek			1,000
Waite Springs Pond			750
Libby, Granite Lake			2,250
Lake Kennedy			2,250
Leigh Lake			2,250
Livingston, Armstrong Spring Creek			3,000
Holliday Spring Creek			5,000
Mission Creek			15,000
Mortimer Spring Creek			3,000
Swindlehurst's pond			8,000
Manhattan, Baker Creek			1,000
Randle Creek			6,000
Woodlawn Pond			6,000
Missoula, Coulon Creek			1,500
Grant Creek			1,500
Lo Lo Creek			2,250
Mill Creek			1,250
O'Brien Creek			1,250
Moore, Rock Creek			2,500
Saltese, St. Regis River and tributaries			4,000
Warren, Bennett Lake			8,000
Wilsall, Flathead Creek			10,000
Nebraska:			
Chadron, Bordeaux Creek			15,000
Chadron Creek			400
Little Bordeaux Creek			15,000
Crawford, Soldier Creek			8,000
Gretna, Fairfield Creek			3,000
Rushville, White Clay Creek			800
Nevada:			
Ely, Illapah Creek			1,200
Reno, Hunter Creek			2,000
Truckee River			800
Spring Creek			400
Verdi, State fish commission	50,000		
New Hampshire:			
Berlin, Bald Mountain Pond			400
Bean Brook		6,000	
Chickwolnepy Creek		12,000	
Horne Brook		6,000	
Jerico Brook		4,000	
Munn Pond		20,000	
Silver Run		6,000	
Success Pond			600
Canaan, India Run		12,000	
Mascoma River		15,000	
Candia, Brown Brook			200
Campton, Kloiner Berg Pond		5,000	
Charlestown, Great Brook		8,000	
Reservoir Brook		6,000	
Concord, Bow Brook Pond			300
Suncook River		25,000	
Derry, Abbott Creek		5,000	
Poor Farm Creek		5,000	
West Running Creek		5,000	
Elmwood, Russell Brook			150
Straw Brook			150
Epsom, Mountain Brook		12,000	
Exeter, Gig Mill Brook		8,000	
Thompson Brook			200
Franklin, Gall Brook		5,000	
Chase Brook			200
Knox Brook			200
Mountain Brook		6,000	
Putney Brook		5,000	
Groveton, Stratford Bog Pond			500
Hill, Flanders Brook		6,000	

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New Hampshire—Continued.			
Hinsdale, Crowningshield Brook		5,000	
Gid Thomas Brook		6,000	
Lily Pond Brook		5,000	
Keene, Alstead Brook			500
Jaquith Brook			500
Surry Brook			500
Littleton, Ammonusuc River		20,000	
Cushmans Brook		4,000	
Rankin Brook		4,000	
Manchester, Bedford Brook			200
Catamount Brook			500
Cemetery Brook			200
Dumpling Brook			500
Little Cohas Brook			200
Little Brook			200
Menter Brook			400
Peters Brook			200
Reservoir Brook			200
Sand Creek			500
Shepards Brook			200
Tannery Brook			200
Uncanoonuc Brook			200
Walker Brook			200
Nashua, Belknap Brook		8,000	
Brickyard Brook		8,000	
Chase Brook		6,000	
Gibson Brook		5,000	
Glover Brook		5,000	
Hills Brook		6,000	
Muddy Brook		6,000	
Tandy Brook		5,000	
Newport, Claggetts Pond		5,000	
Pinnacle Pond			200
Potter Place, Cole Pond		15,000	
Pleasant Lake			450
Rochester, Green Hill Brook		3,000	
Short Falls, Sparlin Brook			150
South Brookline, Rockwoods Pond		5,000	
Troy, Farrar Brook			200
Mountain Brook			200
Wilton, Blood Brook		8,000	
Hodgdon Brook		8,000	
Winchester, Mira Brook			500
New Mexico:			
Buckman, Rito de los Frijoles			750
Dexter, Lake Van			125
Fierro, Mimbres Creek			250
Hagerman, railroad reservoir			125
Hanley, Vigil Creek			375
Las Vegas, Beaver Creek			300
Gallinas River and branches			1,200
Silver City, Cow Creek			250
Meadow Creek			250
Whitewater Creek			375
Taiban, Taiban Creek			125
Ute Park, Rio Grande tributaries			400
Wagon Mound, Tison Spring Run			150
New Jersey:			
Oxford, Pequest River			300
Princeton, applicant	600		
Rochelle Park, Saddle River			1,200
Salem, Cool Run		8,000	
New York:			
Adams, Raystone Creek		25,000	
Sandy Creek, North and South Branches		40,000	
Apulia, French Brook			100
Maskhaw Brook			100
Ranger Brook			50
Wills Brook			200
Battery Park, New York Aquarium	5,000		
Beaver River, Beaver River			253
Benson Mines, Ellis Brook		10,000	
Little River		15,000	
Tamarack Creek		15,000	
Berlin, Little Hoosick River			2,000
Big Indian, Esopus Creek			1,500
Buffalo, State Cancer Laboratory			54

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New York—Continued.			
Cambridge, Coulten Brook		10,000	
Cottrells Brook		5,000	
Canaan, Funnell Canaan Center Pond			700
Canton, Little River		30,000	
Carmel, Croton River		15,000	
Catskill, Kiskaton Creek			300
Cornwall, Awessema Creek		4,000	
Mineral Spring Brook		4,000	900
Cortland, Messenger Creek		15,000	
Delhi, Elk Creek		5,000	
Peakes Creek		5,000	
Steels Brook		5,000	
Forestport, Little Woodhull Brook			300
Georgetown Station, Gladding Brook		5,000	
Mann Brook		10,000	
Mariposa Creek		10,000	
Plank Creek		5,000	
Thompson Brook		5,000	
Gouverneur, Huckleberry Lake		25,000	
Keene Creek		15,000	
Mud Lake		25,000	
Sunshine Lake		15,000	
Greene, Carter Brook		5,000	
Crandal Brook		10,000	
Indian Brook		10,000	
Peck Brook		10,000	
Wheeler Brook		10,000	
Winston Brook		10,000	
Harriman, Lake Frederick			1,500
Harrisville, Big Hill Pond		25,000	
Hartsdale, Rum Brook			700
Homer, Crorises Pond		20,000	
Lake Mahopac, Lake Mahopac			2,075
Lake Placid, Winch Pond			250
Larchmont, Pine Brook			600
Lincolndale, Lake Lincolndale			2,400
Madawaska, Quebec Brook			1,500
Massena, Bennetts Pond			50
Mills, Hartford Creek			500
Millbrook, Omruavarra Brook			300
New City, Crum Creek Pond			1,000
Newton Falls, Moosehead Lake		25,000	
New Lebanon, Burnemead Brook			500
Dean Brook			1,000
Hull Brook			1,000
Meander Brook			500
West Meadow Brook			1,000
Wyomonock Creek			2,000
North Creek, North Creek			2,000
Wakeley Brook			1,500
Northville, Charley Lake		20,000	
Coonis Lake		15,000	
Howland Run		5,000	
Priest Vlaie Run		5,000	
Rhudes Vlaie Run		5,000	
Nyack, Larchdell Ponds		4,000	
Oneonta, Baker Brook		4,000	
Ford Brook		5,000	
Hotaling Hollow Creek		6,000	
Huyck Brook		4,000	
Mill Creek		8,000	
Norton Brook		3,000	
Otego Creek and tributaries		15,000	
Patterson, Croton River			400
Quaker Brook			300
Port Henry, Buck Pond		10,000	
Club House Pond		15,000	
Lower Moss Pond		10,000	
Schroon River		10,000	
Secret Pond		10,000	
Upper Moss Pond		10,000	
Port Jarvis, Bushkill Brook			1,000
Cahoonzie Park Lake			1,000
Shinglekill Brook			1,000
Steeneykill Brook			1,000
Potsdam, Cutting Brook		6,000	
Peck Brook		6,000	

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New York—Continued.			
Potsdam, Rutman Brook		6,000	
Sanford Brook		6,000	
Trout Brook		16,000	
Richfield Junction, Bridgewater Creek		15,000	
Rockville Center, Trout Lake			200
Rome, Dirreen Brook			1,000
Fish Creek		30,000	
Pringle Brook			1,000
St. Regis Falls, East Brook		20,000	
Salisbury Center, Fly Creek		10,000	
Schenectady, Alplans Creek		15,000	
Lishaskill Creek		10,000	
South Berlin, Kronk Brook		10,000	
Springville, Foote's pond			1,000
Stephentown, Black River			2,500
Browns Brook			1,000
Chapel Creek			1,500
Douglas Brook			1,000
Kinderhook Brook			2,000
Roaring Brook			1,000
Syracuse, Carpenter Brook		6,000	
DeMontfredy Brook		6,000	
Geddes Brook			100
Mount Friedel Run		10,000	
Pecks Brook			100
Pools Brook			250
Thurman, Viele Pond		2,500	
Troy, Poesten Kill River, tributary		8,000	
Watertown, Brownville Creek		10,000	
Felts Mills Creek		15,000	
Frenches Creek		5,000	
Johnsons Creek		10,000	
Kings Creek		10,000	
Moshers Pond		10,000	
Stebbins Creek		10,000	
Twin Ponds		10,000	
West Creek		20,000	
Whites Creek		10,000	
Williamstown, Salmon River		20,000	
Winthrop, Davis Brook		10,000	
North Carolina:			
Barnard, Sugar Camp Branch			1,500
Black Mountain, Big Piney Branch			500
Lookout Branch			1,000
Canton, Arthurs Creek			3,000
Bee Creek			3,000
Hungry Creek			3,000
Pisgah Creek			3,000
Cherryfield, French Broad River, South Fork			1,600
Indian Creek			800
Kitchens River			2,400
Parkers Creek			2,400
Shoal Creek			800
Tuckers Creek			1,600
Dillsboro, Nations Creek			4,500
Elk Park, Fall Creek			6,000
Little Elk Creek			7,000
Hendersonville, Fall Creek			800
Little Hungry Creek			1,600
Sugarloaf Creek			800
Horseshoe, Rocky Park Creek			1,600
Rush Creek			800
Kellersville, Beech Creek			6,000
Buckeye Creek			6,000
Laurelton, Shelton Laurel River			10,000
Marble, Vengences Creek			4,500
Minneapolis, Toe River and tributaries			10,500
Montezuma, Grandmother Creek			8,000
Kawana Lake			5,000
Linville River			11,000
West Fork Creek			3,000
Rosman, Ballard Branch			800
Camp Branch			800
French Broad River, Middle Fork			800
Holcomb Branch			800
Indian Camp Brook			800
Shoal Creek			800

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
North Carolina—Continued.			
Sylva, Beef Market Creek			3,000
Bens Branch			1,500
Buck Knob Creek			3,000
Caldwell Creek			4,500
Camp Creek			1,500
Dills Creek			3,000
Dills Pond			1,500
Dillard Creek			1,500
Ensley Creek			4,500
Fisher Creek			3,000
Garrett Branch			1,500
Pinnacle Creek			1,500
Round Bottom Branch			3,000
Tuxedo, Camp Creek			4,500
Freemans Mill Creek			3,000
Jones Creek			9,000
Little Laurel Creek			3,000
Waynesville, Bennetts Creek			4,500
Big Cove Branch			1,500
Bull Pen Creek			4,500
Eagle Nest Creek			3,000
Harrison Branch			1,500
Howell's Branch			3,000
Hyatts Branch			1,500
Indian Creek			1,500
Love Branch			1,500
Pigeon River			6,000
Sally Hannah Branch			6,000
Smith Creek			1,500
Smoky Branch			1,500
Sorrells Creek			3,000
Spruce Branch			1,500
Woodys Creek			1,500
Ohio:			
Bellefontaine, Mad River, branch of		20,000	
Castalia, applicant	50,000		
Cold Creek		32,000	
Cleveland, Sand Rock Pond		8,000	
Columbus, Esswein Lake			800
Mansfield, Bentleys Creek		15,000	
Calhoun Run		10,000	
Clear Fork River, South Branch		25,000	
Coes Run		10,000	
Cullers Run		15,000	
Fikes Pond		5,000	
Manners Run and Lake		10,000	
Rutgen Run		15,000	
Spring Water Run		15,000	
Touby Run		15,000	
Oregon:			
Bonneville, State fish commission	50,000		
Carlton, North Yamhill River		3,000	
Clackamas, Little Clear Creek		5,000	
Eugene, Indian Creek		2,000	
Hood River, Carter's lake		3,200	
Paradise Lake		1,200	
La Grande, Mill Creek		1,700	
Pendleton, Bear Creek		1,200	
Birch Creek, East Fork		1,200	
Pilot Rock, Big Creek		1,600	
Bridge Creek		1,200	
Cable Creek		1,000	
Camas Creek		1,600	
Five Mile Creek		1,000	
Hidiway Creek		1,100	
Owens Creek		1,200	
Snipe Creek		1,200	
Portland, Cedar Creek		2,000	
Ranier, Spring Brook		800	
Salem, Battle Creek		2,400	
Pennsylvania:			
Ackermanville, Ackermanville Creek			200
Old Delebole Creek			200
Alba, Cold Spring Run			1,000
Mill Creek			2,000
Moores Branch			1,000
Rock Run			1,000
Spring Brook			1,000
Two Mile Run			1,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Allentown, Cedar Creek		6,000	
Spring Creek		4,000	
Ashland, Big Roaring Creek		4,000	
Huffnagle Creek		4,000	
Annville, Indiantown Creek		8,000	150
Killingers Creek		4,000	150
Lights Creek		6,000	150
Raccoon Creek		6,000	
Riegerts Run		6,000	
Snitz Creek		6,000	
Aughanbaugh, Aughanbaugh Run			600
Benton, McHenry Run			500
Bethlehem, Martins Creek		4,000	
Monocacy Creek		6,000	
Bloomfield, Perry Furnace Run			100
Witherow Run			100
Bradford, Chapple Fork Creek			1,800
Fuller Brook			1,800
Sugar Run			1,800
Sugar Run, North Branch			1,800
Tuna Creek, East Branch			1,800
Tuna Creek, West Branch			1,800
Willow Creek			1,800
Cammal, Mill Creek			2,000
Canton, Mill Creek			1,200
Rathbone Creek			1,000
Carlisle, Cedar Run			100
Tumbling River			100
Yellow Breeches Creek			3,000
Catasauqua, Fullers Run			200
Cedar Hollow, North Valley Creek			1,000
South Valley Creek			1,000
Central, Fishing Creek			2,000
Centralia, Hells Kitchen Creek			4,000
Whiskey Mill Hollow Creek			4,000
Chambersburg, Birch Run			2,000
Carbaugh Run			1,000
Cold Spring Run			1,000
Falling Spring Run			1,000
Hosack Run			1,000
Pine Run			1,000
Chesterbrook, South Valley Creek			1,000
Trout Creek			500
Valley Creek			1,000
Cheyney, Walhalla Brook			500
Clarendon, Dandy Run			1,200
East Branch			1,200
Farnsworth Creek			3,000
Long Branch			1,200
Mud Run			1,200
Underwood Run			600
Clearfield, Antis Run			1,000
Bald Hill Run			1,000
Big Trout Run			3,000
Big Trout Run, Left Branch			3,000
Big Trout Run, Right Branch			3,000
Bloody Run			1,000
Browns Run			1,000
Cole Run			1,000
Crooked Run			1,000
Curry Run			2,000
Dales Run, Left Branch			1,000
Dales Run, Right Branch			1,000
Deer Creek			2,000
Dixon Run			1,000
Forceys Run			1,000
Gifford Run			1,000
Graffins Run			1,000
Grahams Run			1,000
Laurel Run			1,000
Lick Run			2,000
Little Medix Run			1,000
Litz Run			1,000
Medix Run			2,000
Merovian Run			1,000
Millstone Run			2,000
Montgomery Creek			2,000
Montgomery Creek, Left Branch			1,000
Montgomery Creek, Right Branch			1,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Clearfield, Moose Creek			2,000
Moose Creek, Left Branch			1,000
Moose Creek, Right Branch			1,000
Morgan Run			2,000
Mosquito Creek			3,000
Mosquito Creek, Left Branch			1,000
Orr Run			1,000
Owens Run			1,000
Pine Run			1,000
Pleasant Valley Run			2,000
Potts Run			1,000
Sandy Creek			1,000
Shopes Run			1,000
Stone Run			1,000
Stump Lick River			1,000
Survey Run			1,000
Woolf Run			1,000
Coles Creek, Bell Run			500
Black Brook			500
Black Run			500
Blish Brook			500
Boston Run			500
Buckalew Run			500
Culvert Run			500
Gearhart Run			500
Hinton Run			500
Maple Run			500
Moss Branch			500
Parker Brook			500
Pine Creek			500
Pine Run			500
Roberts Run			500
Spring Run			500
Stevens Creek			500
Sutliffs Run			500
Swains Run			500
Columbia, Austinville Creek			2,000
Bullard Creek			1,000
Fellows Creek			1,000
Garnert Creek			1,000
Griffith Creek			1,000
Morgan Creek			1,000
Sugar Creek			4,000
Tiogo River			3,000
Wolfe Creek			1,200
Cresco, Bushkill River			1,750
Paradise Creek			1,750
Dahoga, Wolfe Run			1,200
Dilltown, Brackens Mill Creek			50
Stephens Sawmill Run			50
Dresher, Pennypack Creek		8,000	
Dubois, Baker Creek			500
Bear Run			1,000
Bell Run			1,500
Burnetts Branch			1,500
Big Anderson Creek			1,500
Blooms Run			500
Burns Run			500
Clear Run			500
Cold Run			500
Cupler Run			500
Cupler Run, East Branch			500
Falls Creek			500
Gravel Lick Run			500
Irvin Run			500
Kyle Run			500
Little Anderson Creek			1,000
Little Montgomery Run			1,000
Little Rattlesnake Run			1,000
McKewn Run			500
Montgomery Run			500
Mountain Run			500
Narrows Creek			1,000
Painter Run			500
Rattlesnake Creek			1,000
Rock Run			500
Stony Run			500
Wolf Creek			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Ebensburg, Blacklick Pond			100
Conemaugh River, North Branch			50
Ephrata, Cocalico Creek		6,000	
Fairchance, Zinc Mine Run			850
Galeton, Judson Creek			600
Lyman Run			1,200
Pine Creek, Rose Branch			500
Pine Creek, South Branch			1,000
Wetmore Run			800
Gap, Ellmaker Run			500
Hathaway Run			500
Livingstons Run			800
Townsends Sawmill Run			800
Umbletown			800
Garden, Trout Creek			500
Valley Creek			1,000
Glen Iron, Laurel Run			1,000
Henderson, Crow Creek			500
Gulph Creek			500
South Gulph Creek			500
Hoadleys, Middle Creek			150
Wangum Creek			2,100
Hollidaysburg, Blairs Creek			1,600
Old Town Run			1,200
Hopewell, Beaver Creek			1,200
Maple Run			800
Otts Run			500
Pipers Run			500
Yellow Creek			2,100
Howellsville, North Valley Creek			1,000
South Valley Creek			1,000
Valley Creek			1,000
Huntington, Stone Creek, East Branch			5,000
Johnstown, Alwins Creek			100
Baldwin Run			30
Beaver Dam Creek			100
Bens Creek			2,500
Bens Creek, North Fork			30
Big Spring Run			100
Blue Hole Run			100
Bobs Creek			100
Breastwork Run			100
Brush Creek			100
Brush Run, South Fork			100
Clear Shade Creek			100
Cubb Run			100
Daily Draft Run			30
Dalton Run			100
Dark Shade Creek			100
Dutch Run			100
Elk Run			100
Forwardstown Run			100
Gray Run			30
Hinckson Run			100
Johns Mill Run			100
Jones Mill Pond			100
Lamberts Run			100
Laurel Run No. 1			100
Laurel Run No. 2			30
Laurel Hill Run			100
Little Mill Creek			100
Lost Run			100
Mill Creek			100
Miller Run			100
Mishlers Run			100
O'Connors Run			30
Penn Run			100
Pin Job Run			100
Piney Run			100
Plitcher Run			100
Powder Mill Run			100
Ramsey Run			100
Red Run			30
Risher Run			30
Rissinger Run			100
Roaring Run			100
Salt Lick Run			100
Sandy Run			30
Shaffer Run			100

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Johnstown, Shannon Run			30
Shingle Run			100
Sugar Run			100
Tub Mill Run			100
Tub Mill Run, Lick Branch			100
Wildcat Run			100
King of Prussia, Crow Creek			500
Gulph Creek			500
Trout Creek			500
Lamar, Fishing Creek			2,000
Lancaster, Cattail Run			500
Little Conestoga Creek, branch of			800
Martins Run			500
Middle Run			800
Stony Run			500
Lanesboro, Brushville Creek			500
Cascade Creek			1,000
Cold Spring Brook			1,000
Dodge Creek			500
Drinker Creek			1,000
Egypt Creek, East Branch			500
Egypt Creek, West Branch			1,000
Hemlock Creek, East Branch			1,000
Hemlock Creek, West Branch			1,000
Roaring Brook			500
Wildcat Creek			500
Latrobe, Kelleys Hollow Run			100
Mill Creek			1,200
Tub Mill Creek			1,000
Lees, North Valley Creek			1,000
South Valley Creek			1,000
Lemont, Bear Meadow Creek			1,000
Cedar Run			1,000
Center Furnace Run			500
Hubler Kettle Creek			500
Galbraith Gap Creek			1,000
Laurel Run			1,000
Roaring Run			500
Shingletown Gap Run			500
Slab Cabin Creek			1,000
Spring Creek			1,000
Stone Creek			2,000
Leola, Groffs Run			800
Ligonier, Mill Creek			100
Lilly, Clearfield Creek			50
Connery Creek			50
Rock Run			50
Lincoln University, Chamberlin Run			100
Lititz, Middle Creek			6,000
Lock Haven, Baker Run			75
Big Buckhorn Run			75
Buckhorn Run			75
Bull Run			1,075
Burges Run			75
Burnt Camp Run			75
Cedar Run			1,000
Chathams Run			2,500
Cherry Run			1,000
Comindiner Run			75
Cow Lick Run			75
Ferney Run			75
Fishing Creek			2,000
Grahms Run			75
Huling Branch			75
Jerry Hollow Run			75
Kirbys Run			75
Lick Run			75
Liget Spring Run			75
Little Cherry Run			1,000
Little Sugar Valley Run			75
Lucas Run			75
McCurdys Run			75
McElhattan Run			75
McKeague Run			75
Mill Run			75
Mosquito Run			75
North Fork Branch			75

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Lock Haven, Pine Run			75
Plum Run			1,075
Poormans Run			75
Queens Run			2,000
Quiggles Run			75
Ram Hollow Run			1,075
Rock Cabin Run			75
Ruddigs Run			75
Scootac Creek			75
Shingle Hollow Run			75
South Fork Branch			75
Spring Lick Run			75
Strawheckers Run			75
Trout Run			75
Twin Run			1,500
Weedon Run			75
Winners Run			75
Wusters Run			75
McVeytown, Locust Run			500
Musser Run			1,600
Price Run			800
Strode Run			2,400
Malins, North Valley Creek			1,000
South Valley Creek			1,000
Maple, Crow Creek			500
Trout Creek			500
Mapleton, Beattys Run			800
Big Laurel Run			800
Hares Valley Creek			1,600
Little Laurel Run			800
Scrub Run			1,600
Trough Creek			1,600
Marsh Creek, Strait Run			1,000
Mauch Chunk, Bear Creek		4,000	
Drakes Creek		4,000	
James Run		4,000	
Mauch Chunk Creek		4,000	
Mud Run		4,000	
Stony Creek		4,000	
Wild Creek		4,000	
Yellow Run		4,000	
Middleport, Lewistown Creek		4,000	
Midvale, Bon Ora Lake			50
Spring Dale Pond			50
Mill Lane, North Valley Creek			1,000
South Valley Creek			1,000
Millville, Battin Run			500
Lick Run			1,000
Milroy, Cooper Run			225
Hayrick Creek			375
Kettle Creek			225
Laurel Run			225
Lingle Creek			150
Stone Creek			375
Minersville, Wolf Creek			150
Monte Alto, Forge Creek			200
Mount Carmel, Lick Run		4,000	
Mount Pleasant, Jones Mill Pond			1,200
Pike Run			2,400
Mount Union, Boohers Gap Run			500
Carmichals Branch			500
Carters Run			1,600
Dark Hollow Run			500
Licking Creek			1,600
McClams Run			500
Old Womans Run			1,200
Roaring Run			800
Roberts Run			1,600
Scrub Gap Run			1,200
Singers Gap Run			1,600
Munson Station, Alder Run			3,000
Benner Run			3,000
Black Bear Run			2,000
Black Moshannon Creek			5,000
Big Basin Run			2,000
Forge Run			4,000
Sandy Run			4,000
Smayes Run			3,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
New Berlin, Benners Run			500
Moss Creek			500
Trout Run			1,500
New Bloomfield, McKees Creek			100
Owings Creek			100
New Centerville, Trout Creek			500
Valley Creek			1,000
Nordmont, Elk Run			2,000
North Bend, Bull Run			1,000
Laurelly Fork Creek			1,000
Lebo Run			1,000
McCraney Run			1,000
Shingle Branch			1,000
Young Womans Creek			1,500
Young Womans Creek, Seven Mile Branch			600
Osceola Mills, Bear Run			2,000
Trout Run			2,000
Orangeville, Mountain Brook			1,000
Paoli Road, North Valley Creek			1,000
South Valley Creek			1,000
Picture Rocks, Deep Hollow Run			500
Eagle Run			500
Granddad Run			500
Little Bear Creek			500
Mill Creek			1,000
Mosers Run			500
Panther Run			500
Pine Run			500
Red Ridge Run			500
Sand Spring Run			500
Shingle Run			500
Sugar Run			500
Philipsburg, Alder Run			100
Ardell Run			100
Bakers Run			100
Barkers Run			100
Bark Shed Run			75
Beans Run			100
Beaver Run			100
Benners Run			100
Bigelows Run			75
Big Spring Run			75
Big Tom Run			100
Bilgers Run			75
Black Bear Run			100
Black Moshannon Creek			100
Butler Run			100
Cabbage Hollow Run			100
California Run			100
Clover Run			100
Cold Run			100
Cold Spring Run			100
Corbin Run			100
Croyles Run			100
Currys Run			75
Dayton Run			100
Deep Rock Run			75
Echo Run			75
Echo Glen Lake			100
Flat Rock Run			100
Forge Run			100
Four Mile Run			100
Hemlock Run			100
Hess Run			100
Hutton Run			75
Huzzards Run			100
Knappers Pond			75
Laurel Run			100
Little Beaver Run			100
Little Tom Run			100
Loop Run			100
McCords Run			100
Meadow Run			100
Morgan Run			100
Musk Run			100
Nasons Run			75
North Run			75

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Philipsburg, One Mile Run			75
Pine Run			75
Potters Run			75
Rock Run			100
Sandy Run			100
Sensers Run			100
Seven Springs Run			100
Sharers Run			100
Shields Run			100
Simcoxes Run			100
Six Mile Run			100
Slate Run			100
Smayes Run			100
Snake Run			75
Splash Run			100
Spruce Run			75
Steiners Run			75
Sterling Run			75
Tacketts Run			100
Tomahawk Run			75
Tom Tit Run			100
Trout Run			100
Turtle Spring Run			75
Twiggs Run			100
Vails Run			100
Whetstone Run			100
Winburne Run			100
Wolf Run			100
Yellow Run			100
Plane Brook, North Valley Creek			1,000
South Valley Creek			1,000
Pleasant View, Pine Creek			150
Stony Run			150
Plum Run, Green Valley Pond			200
Pottsville, Big Creek		6,000	
Eicherts Run		2,000	
Indian Run		2,000	
Tumbling Run		4,000	
Punxsutawney, Little Sandy Creek			1,500
Quarryville, Conowingo Creek			1,000
Conowingo Creek, branch			800
Jackson Run			800
McFarland Run			1,000
Stewarts Run			1,000
Reading, Brunacle Creek			100
Brunnerkiln Creek			150
Cacoosing Creek		4,000	50
Furnace Creek			100
Linden Creek			150
Lylton Creek		2,000	
Plum Creek			100
Six Penny Creek			100
Willow Creek		2,000	100
Reedsville, Honey Creek			800
Retort, Gearhart Run			1,000
Lick Run			1,000
Meadow Run			2,000
Minnie Run			1,000
Trout Run			2,000
Ringdale, Beaver Run			500
Big Run			500
Birch Creek			500
Double Run			500
Dutchmans Run			500
Flood Wood Run			500
Glass Creek			500
Gregs Run			500
Herman Run			500
Laurel Run			500
Lick Run			500
Mill Creek			500
Poll Bridge Creek			500
Roaring Run			500
Rock Run			500
Shanerberg Creek			500
Wolf Run			500
Rockwood, Laurel Hill Creek			300

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.			
Sand Patch, Flaugherty Creek			250
Schuylkill Haven, Long Run Creek		4,000	
Shenandoah, Davis Run		6,000	
Deer Run		6,000	
Shippensburg, Brittons Run			500
Slate Run, Little Slate Run			1,500
Morris Run			1,000
Nabal Run			2,700
Snow Shoe, Beech Creek			1,500
Bennen Run			1,000
Clarks Run			500
Gunsallen Run			500
Hicklin Run			500
Horsehead Run			500
Improvement Run			500
Jonathan Run			500
Lucas Run			500
Mitchells Spring Run			500
Pine Run			1,000
Rankin Run			500
Rock Run			1,000
Sandy Run			1,000
Sterling Run			1,000
Stinktown Run			500
Uzzell Run			500
Wallace Run			1,000
Wolf Run			1,000
Stewartstown, Codorus Creek			1,500
Stillwater, McHenrys Run			500
Stroudsburg, Broadhead Creek			200
Bushkill Creek			100
Cherry Creek			100
Fethermans Run			50
Little Pocono Creek			50
Pocono Creek			300
Rattlesnake Run			50
Reynolds Run			50
Rising Sun Creek			50
Sambo Creek			100
Saw Creek			100
Spagle Run			50
Stony Run			100
Tamaqua, Coal Run, tributary of		2,000	
Tobyhanna, Tobyhanna Creek			200
Towanda, Little Scrader Creek			2,000
Millstone Creek			3,000
Schrader Branch			4,000
Sugar Run			3,000
Troy, Beaver Creek			1,000
Covert Creek			1,000
Mill Creek			2,000
Panther Run			1,000
Tamarack Run			1,000
Vanness Branch			1,000
Webber Creek			1,000
Windy Gap Run			1,000
Trout Run, Clendenen Run			2,000
Uniondale, Lewis Lake Run			500
Valley Store, North Valley Creek			1,000
South Valley Creek			1,000
Villa Nova, Sinnott's pond			100
Waynesboro, Baileys Run			150
Hoovers Run			1,000
Wellsboro, Asaph Run			1,200
Weissport, Mahoning Creek			100
West Chester, Lady Run			200
Lady Run and tributaries			100
Williamsburg, Clover Creek			4,000
Williamsport, Roaring Run			800
Willow Grove, Penapack Creek		8,000	
Windber, Beaver Run			1,600
Lines Run			1,600
Piney Run			1,600
Roaring Fork Creek			1,600
Yellow Springs, Stony Creek		4,000	
York, Bears Run			200
Rhode Island:			
Providence, Angell Brook		5,000	
Tiverton, Boyswood Pond		6,000	

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
South Dakota:			
Buffalo Gap, Beaver Creek			5,000
Caputa, Rapid Creek			25,000
Custer, Flynn Creek			750
Nevin Pond			10,000
Elmore, Spearfish Creek			35,000
Englewood, Little Spearfish Creek, East Fork			5,000
North Elk Creek			15,000
North Rapid Creek, Tilson Branch			5,000
Spearfish Creek, East Branch			12,000
Spearfish Creek, East Fork of East Branch			5,000
Spearfish Creek, Ward Branch			6,000
Whitewood Creek			19,000
Gordon, Wounded Knee Creek			18,000
Hanna, Little Spearfish Creek, East Fork			2,000
Hisega, Rapid Creek			600
Nemo, Box Elder Creek			1,000
Jim Creek			3,000
McCall Creek			5,000
Nisland, Plum Creek			200
Piedmont, Little Elk Creek			10,000
Pluma, Bear Butte Creek			20,000
Rapid City, Bogus Jim Creek			2,000
Minnelusa Brook			3,000
Rapid Creek			25,000
Slate Creek			4,500
Rochford, Little North Rapid Creek			8,000
Rapid Creek, North Fork			12,000
Roubaix, Dahlequist Creek			8,000
Sisseton, Booske Creek			380
Carters Creek			290
Demmicks Creek			380
Jim Creek			380
Joe Creek			380
Long Hollow Creek			380
Schindler Creek			380
Wakeman Creek			380
Spearfish, Chicken Creek			6,000
Hiltons Gulch Run			5,000
Lindley Spring Branch			5,000
Lower Crow Creek			6,000
McGregor's pond			4,000
Rushton Creek			6,000
Rushton Pond			6,000
Spearfish Creek			20,000
Water Cress Creek			12,000
Tennessee:			
Big Sandy, McCraes Branch			2,000
Concord, Turkey Creek			2,000
Del Rio, Big Creek			13,000
Wolf Creek, Feds Fork Creek			1,600
Wolf Creek			2,400
Utah:			
Erda, Smith's pond			150
Logan, Bowen's pond			200
Jensen's springs			400
Koller's ponds			800
Mikkelson Spring Pond			400
Moser Spring Creek			200
Milford, Lang's pond			150
Park City, Page Spring Pond			400
Smithfield, Fishburn Slough			200
Woods Cross, Pelton's pond			400
Vermont:			
Arlington, Benedict Brook		4,000	
Canfield Brook		3,000	
Deming Brook		3,000	
Favill Creek		10,000	
Parsons Brook		3,000	
Reed Brook		3,000	
Barre, Rice Lot Brook		4,200	
Winooski River			1,000
Barton, May Pond			1,500
Bennington, Basin Brook		2,500	
Bickford Hollow Brook		6,750	
Broad Brook		4,000	
Brown Brook		3,250	
Bushnell Brook		2,500	
Chase Brook		5,750	
Dewey Brook		2,500	

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Vermont—Continued.			
Bennington, Dunvill River		8,000	
Evans Brook		2,500	
Furnace Brook		6,750	
Little Hell Hollow Brook		2,500	
Little Pond Brook		2,500	
Lyman Lot Brook		2,500	
Mill Brook		5,000	
Perry Thompson Brook		4,000	
Redfield Brook		2,500	
Rider Brook		2,500	
Roaring Branch		3,250	
Rockwood Brook		3,250	
South Stream		4,000	
Still Brook		2,500	
Stillwater Brook		3,250	
Stratton Brook		2,500	
Walloomsac River		12,500	
Waters Brook		2,500	
Woodford City Brook		3,250	
Woodford City Pond		10,000	
Bellows Falls, Morse Brook		5,000	
Saxtons River and tributaries		10,000	
Brattleboro, Alexander and Rudd Brook		4,000	
Bonivale Brook		4,000	
Brickyard Brook		4,000	
Halliday Brook		4,000	
Meadow Brook			1,000
Slate Rock Brook		4,000	
Whetstone Brook		4,000	
Cambridge Junction, North Branch			2,500
Canaan, Big Averill Lake		12,000	
Forest Lake		8,000	
Lewis Pond		12,000	
Little Averill Lake		12,000	
Cuttingsville, Farrell Brook		3,000	
Phillips Brook		3,000	
Shrewsbury Pond			3,500
Spring Lake		14,000	
Danville, Brown Brook			1,500
Crane Brook			1,000
Joes Brook		6,000	
East Ryegate, Manchester Brook			1,500
Ely, Bear Notch Run			4,000
Brown Brook			2,000
Greensboro, Baker Brook			500
Caspian Lake			4,000
Little Porter Brook		3,000	
Porter Brook		3,000	
Groton, Darling Pond		125,000	15,000
Hardwick, Lamoille River			2,000
Hartford, Standing Pond			5,000
Holden, Furnace Brook			27,000
Holden Brook			1,000
Jamaica, West Jamaica Brook			2,000
Johnson, Lamoille River, Waterman Branch			1,200
Lyndon, Gilbert Brook		4,200	
Hawkins Brook		6,720	
Houghton Brook		4,200	
Kirby Pond			1,000
Kirby Pond Brook		12,600	
Sheldon Brook		3,360	
Smith Brook		6,200	
South Wheelock Brook		10,080	1,000
Lyndonville, Passumpsic River, West Burke Branch		12,600	2,500
Passumpsic River, West Branch			2,000
Willow Pond			5,000
Manchester, Battenkill River		56,000	
Marshfield, Niggerhead Pond			2,500
Montpelier, Beaver Meadow Brook			1,000
Great Brook		4,200	
Herrick Brook			800
Long Brook		6,720	
Mallory Brook			1,200
Minister Brook			1,000
Shady Rill Brook		4,200	
Upper Martin Brook			1,200
Verge Pond			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Vermont—Continued.			
Morrisville, Burke Brook		2,000	
McNall Brook		3,000	
North Bennington, Cold Spring Brook		4,000	
Northfield, Stone Brook		4,000	
Norwich, Blood Brook		5,000	
Brown Brook		5,000	
Lake Mitchell		75,000	
Turnpike Brook		5,000	
Pittsford, Furnace Brook, branch of		10,000	
Sugar Hollow Brook			2,000
Plainfield, Laird's pond			2,500
Nasmith Brook		8,400	
Winooski River		6,720	
Poultney, Poultney River		25,000	
Pownal, Ladd Brook		5,000	
Proctor, Manley Pond			2,000
Toms Reservoir			2,000
Proctorsville, Williams River		9,000	
Randolph, Adams Brook		3,350	
Annis Brook		2,500	
Bear Hill Brook		3,250	
Blanchard Brook		3,250	
Bowman Brook		3,250	
Chandler Brook		4,000	
Clough Brook		3,250	
Fishers Brook		2,500	
Guild Brook		3,250	
Halfway Brook		8,500	
Howard Hill Brook		3,250	
Mafeba Lake			1,000
Meadow Brook		2,500	
Mud Pond		12,500	
Poverty Lane Brook		3,250	
Roods Brook		2,500	
Roxbury Brook		3,250	
Snows Brook			1,200
Spears Brook		3,350	
White River, Middle Branch		17,000	
Readsboro, Howe Pond			1,000
Roxbury, Little Northfield Brook		8,500	
State Hatchery Ponds			300
Rupert, White Creeek		5,000	
White Creek, tributary of		5,000	
Rutland, Castleton River		12,000	
Cold River, North Branch		15,000	
East Creek, Chittenden Branch		12,000	
Furnace Brook		12,000	
Pico Pond			2,000
St. Johnsbury, Cliff Pond			2,000
Crow Hill Ponds			2,000
Duck Pond Brook and tributaries			500
Frog Pond		2,500	500
Meadow Brook		4,000	
Salisbury, Dutton Brook		4,000	
Inglas Brook		4,000	
Sucker Brook		8,000	
Shaftsbury, Peter Mattison Branch		12,500	
Sharon, Lake Mitchell		45,000	15,000
South Royalton, Alco Pond		15,000	
Bailey's pond		4,200	
South Ryegate, Hatch Pond			3,000
Long Pond		16,800	
Wells River		12,600	
South Shaftsbury, Marshall Brook		5,000	
Townsend, Chaffee Brook			2,500
Walden, Haynesville Brook		5,000	
Rocks Brook			1,500
Wells River Club Pond			3,500
West Hartford, Meadow Brook		5,000	
Sunny Brook		3,000	
Windsor, Blanchards Brook		4,000	
Lull Brook		4,000	
Mill Brook		5,000	
Mill Brook and branches		12,000	
Woodstock, Meccane Pond		20,000	
Prosper Brook		4,000	
Quiete Trout Pond		5,000	
Tarn Pond		3,000	

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Virginia:			
Amherst, Buffalo River			400
Arcadia, North Creek			300
Bedford City, Stony Creek			200
Big Island, Battery Creek			1,500
Reed Creek			1,000
Callaghan, Cove Run			1,500
Clifton Forge, Simpsons Creek, North Branch			500
Wilson Creek			164
Coeburn, Little Toms Creek			500
Elgin, Hazel River, North Fork			2,250
Hazel River, South Fork			2,250
Harrisonburg, Dry River			3,000
Harriston, Big Branch			1,500
Moormans River			1,500
Huntley, Indian Run			3,000
Lynchburg, Sherman Pond			100
Maurertown, Cedar Creek			3,000
Patrick Springs, Spoon Creek			400
Pulaski, Tract Branch			100
Rural Retreat, Cripple Creek			500
Staunton, Ramseys Run			4,000
Wytheville, Tates Run			135
Washington:			
Addy, Blue Lake			1,000
Bossburg, Lake Phalon			2,000
Chehalis, Lucas Creek		1,200	
East Clallam, Pysht River		4,000	
Goldendale, Little Klickitat River		3,950	
Montesano, Stockwell's pond			750
Seattle, Gorse River		1,600	
Grays Marsh River		2,000	
Maple Brook		1,600	
Union River		1,600	
Wall, State fish commission	50,000		
Wilkeson, Snell's lake		800	
South Prairie, East Fork		800	
West Virginia:			
Belington, Johnson's mill pond			360
Viquesney Pond			300
Burner, Clubhouse Run			1,500
Harper Run			1,000
Little River			4,000
Span Oak Run			1,500
Cowen, Williams River, Middle Fork			4,000
Durbin, Meadow Pond			900
Elkins, Chenoweths Creek			200
Gladwin, Glady Fork Creek			6,400
Glady, Glady Fork Creek, East Fork			200
Glady Fork Creek, Right Fork			200
Hancock, Meadow Branch			4,000
Harmon, Teter's pond			300
Horton, Big Run			300
Dry Fork River, Gandy Fork			960
Seneca Creek			400
Huntington, Kessler's pond			700
Huttonsville, Scott's pond			200
Jenningston, Laurel Fork Creek			400
Kerens, Clifton Run			200
Keyser, Mill Run			2,000
Kingston, Paint Creek			5,000
Marlinton, Knapp Creek			95
Stony Creek			600
Midvale, Cassity Fork Creek			3,000
Long Run			3,000
Middle Fork River			10,600
Pleasant Run			1,500
Montes, Red Run			1,500
Morgantown, Monongahela River			2,000
Porterwood, Pleasant Run			300
Richwood, Cherry River and tributaries			6,000
Romney, Mountain Run			1,600
Seebert, Sugar Grove Pond			500
Sitlington, Galfords Creek			2,500
Stony Run			1,500
Springdale, Sewell Creek			300
Tunnelton, Little Sandy Creek			800
White Sulphur Springs, Dutch Run		48,568	
Howard Creek		2,938	2,289
Mill Creek			800

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
West Virginia—Continued.			
Winterburn, Greenbrier River, Buffalo Fork			3,000
Greenbrier River, East Fork			10,300
Wisconsin:			
Abbotsford, Eau Plain River			4,000
Alma, Alitz Creek			250
Braem Creek			250
By-Golly Creek			250
Gaeble Creek			250
Hutchinson Creek			250
Johns Valley Creek			750
Kastes Creek			250
Lee Valley Creek			250
Leonhardy Creek			250
Little Waumandee Creek			1,000
Mill Creek			1,250
Muellers Creek			250
Netting Creek			250
Pine Creek			250
Risch Creek			250
Schaubs Creek			250
Schmidts Creek			250
Schultz Creek			250
Spring Creek			250
Tamarack Valley Creek			250
Trout Creek			250
Wingert Creek			250
Wolfs Creek			250
Alma Center, Dunns Creek			250
Halls Creek			250
North Branch Creek			500
Stockwell Creek			500
Town Creek			250
Almena, Hay River			4,800
Amherst, Sannes Creek			800
Waupaca River			3,600
Waupaca River, North Branch			1,200
Antigo, Ackerman Lake			1,200
Black Creek			1,700
Browns Lake			1,200
Eau Claire River, East Branch			750
Eau Claire River, South Branch			600
Eau Claire River, West Branch			750
Evergreen Creek, West Branch			1,200
Kennedy Lake			1,200
Pine Creek			1,200
Pine River			750
Section Line Creek			600
Spring Brook			1,800
Thompson Lake			1,200
Arcadia, American Valley Creek			2,400
Eagle Valley Creek, West Branch			2,400
Glencoe Creek, North Branch			2,400
Glencoe Creek, West Branch			2,400
Meyers Valley Creek			2,400
Newcomb Valley Creek			2,400
Bagley, Big Sandy Creek			500
Baldwin, Kinnickinnick River			4,000
Rush River			4,000
Bangor, Adams Valley Creek			500
Anderson Creek			250
Big Creek			500
Burns Creek			500
Coon Valley Creek			500
Dutch Creek			500
Eynons Creek			250
Holberg Creek			250
Langrer Creek			250
Little Creek			250
Sand Creek			500
Youngs Creek			250
Barneveld, Eveland Creek			250
Hayes Run			3,000
Lanpop Run			250
O'Neil Creek			250
Shannon Creek			3,000
Smiths Run			3,250
Tvedt Creek			1,000
Blair, Bear Creek			1,850
Beaver Creek			1,600

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Blair, Fly Creek			1,600
French Creek			1,600
Jodalen Creek			1,600
Johnson Coulee Creek			200
Lake Coulee Creek			250
Larolds Creek			250
Nordhaus Creek			1,600
Ore Coulee Creek			200
Paterson Pond			250
Pine Creek			1,600
Qualley Creek			200
Quammen Creek			200
Reynolds Creek			250
Skuttey Creek			1,600
Strum Creek			1,600
Taraalson Creek			250
Teppe Creek			1,600
Tippen Coulee Creek			250
Trump Creek			1,850
Twesme Creek			400
Vasse Coulee Creek			1,850
Washington Creek			200
Welsh Coulee Creek			250
Blue Mounds, Brunners Creek			3,000
Dimples Creek			2,000
Frame Creek			2,000
Handels Creek			2,000
Moyers Creek			500
Ryans Creek			3,750
Steyer Creek			750
Camp Douglas, Little Lemonweir River			1,000
Cashton, Bohemian Valley Creek			2,250
Bruha Spring Run			250
Brush Creek			2,250
Brush Creek, South Branch			500
Coles Valley Creek			2,250
Coon Creek			250
Grononns Valley Creek			2,000
Hall Creek			2,000
Heiser Valley Creek			250
Jersey Valley Creek			2,250
Meisner Valley Creek			2,250
Neiser Valley Creek			2,000
Pleasant Valley Creek			2,000
Russell Creek			2,500
Shotten Creek			250
Taylor Creek			250
Timber Coulee Creek			2,000
Witchman Brook			2,250
Chippewa, Big Drywood Creek, tributaries			500
Bob Creek, branches of			750
Duncan Creek, tributaries			750
Elk Creek, tributaries			750
Little Drywood Creek, tributaries			500
Mudbrook Creek, branches of			750
Stilson Creek			250
Clear Lake, Hay River, North Fork			3,200
Colfax, Bronken Creek			2,400
Eighteen Mile Creek			2,400
Eighteen Mile Creek, North Fork			3,200
Eighteen Mile Creek, South Fork			2,400
Haugle Creek			3,200
Trout Creek			3,200
Coloma, Wedde Creek			5,000
Cross Plains, Black Earth Creek			2,000
Black Earth Creek, branch			2,000
Cumberland, Hay River			3,200
Miller Creek			3,200
Sand Creek			3,200
Dodgeville, Anderson Creek			500
Boltz Creek			3,250
Bowdamans Creek			3,000
Davies Branch			250
Edmunds Pond			250
Engels Branch			1,000
Furnace Flat Creek			250
Garrison Grove Creek			250

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Dodgeville, Hendrickson Creek			250
Jones Branch			750
Lime Kiln Brook			2,000
McCluskey Branch			250
Martins Branch			1,000
Meiss Branch			250
Mylroies Branch			250
Pengilly Run			2,250
Wedlakes Creek			250
Williams Creek			250
Durand, Alkire Creek			250
Bear Creek			400
Big Arkansaw Creek			400
Big Coulee Creek			400
Big Plum Creek			400
Brunner Creek			250
Fall Creek			400
Fox Creek			250
Harrow Creek			200
Hay Creek			250
Little Arkansaw Creek			400
Little Bear Creek			400
Little Missouri River			250
Little Plum Creek			250
Newton Brook			250
Porcupine Creek			400
Spring Creek			250
Stanton Creek			250
Troy Creek			200
Wilson Creek			250
Eagle River, Wisconsin River, tributary of			1,800
Eau Claire, Ash Creek			1,750
Eleva, Adams Creek			2,400
Big Creek			2,650
Trout Creek			500
Elmwood, Big Missouri Creek			1,600
Eau Galle River			1,600
Gilbert Creek			1,600
Kady Creek			1,600
Knights Creek			1,600
Little Missouri Creek			1,600
Lousey Creek			1,600
Mosourie Creek			1,600
Plum Creek			1,600
Porter Creek			1,600
Rush River			1,600
Ellsworth, Beldenville Creek			250
Big Coulee Creek			250
Big River			250
Brush Creek			1,850
Cave Creek			1,850
Coulee Creek			1,600
Gilbert Springs Run			1,600
Gillman Creek			250
Goose Lake			1,600
Isabelle Creek			1,850
Little Coulee Creek			1,600
Little Trimbelle Creek			1,850
Lost Creek			1,850
Rush River			500
Spring Brook			1,850
Trimbelle Creek			2,100
Fennimore, Grant Creek, Wilkes Branch			250
Green Creek			1,000
Fond du Lac, Byron Camp Ground Creek			2,000
Parsons Creek			2,000
Fountain City, Bohris Valley Creek			1,600
Eagle Valley Creek			2,400
Eagle Valley Creek, East Branch			1,600
Waumandee Creek			2,400
Foxboro, Big Balsam Creek			4,000
Empire Creek			4,000
State Line Creek			4,000
Galesville, Bear Creek			2,650
Beaver Creek			500
Beaver Creek, North Branch			400
Beaver Creek, South Branch			400

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Galesville, Duck Creek			250
Dutch Creek			1,600
French Creek			2,650
Grants Creek			1,850
Halfway Creek			2,400
Hardies Creek			1,850
Holcomb Coulee Creek			1,600
Lewis Valley Creek			2,400
North Beaver Creek			2,400
Pine Creek			2,400
South Beaver Creek			2,400
Tamarack Creek			2,600
Gays Mills, Talman Creek			1,000
Gleason, Prairie River			1,575
Glenwood City, Beresford Creek			250
Eldridge Creek			250
Ryans Creek			250
Hackley, Cedar Creek			750
Hackley Creek			250
Twin Creek			500
Harrison, Prairie River, branch of			3,000
Hatley, Plover River			1,500
Hawkins, Deer Creek			300
Grass Creek			300
Little Jump River			300
Main Creek			300
Skinner Creek, North Fork			300
Skinner Creek, South Fork			900
Stony Brook			300
Hayward, Bean Brook			2,400
Big Brook			2,400
McDermott Brook			1,600
Mosquito Brook			2,400
Namakagon River			4,000
Spring Brook			2,400
Hixton, Amo Creek			725
Bailey Creek			1,000
Beaver Creek			1,825
Cursan Creek			1,600
Ellington Creek			1,600
Galster Creek			1,825
Holmes Creek			1,825
Hulet Creek			500
Judkins Creek			1,825
Kretcher Creek			500
Larson Creek			1,825
Lowe Creek			1,825
Mortiboy Creek			1,600
Nettleton Creek			500
North Branch			1,600
O'Halleran Creek			500
Olson Creek			1.000
Pigeon Creek			2,400
Pine Creek			1,225
Sechler Creek			500
Sherwood Creek			1,600
Sly Creek			1,825
South Branch			1,600
Stoddard Creek			1,000
Tank Creek			1,825
Timber Creek			1,825
Trempeauleau River, North Branch			450
Independence, Bennet Valley Creek			1,000
Borst Valley Creek			750
Bruce Valley Creek			750
Burts Creek			750
Chimney Rock Creek			750
Cookes Creek			750
Dubils Creek			750
Elk Creek			500
Elk Creek, tributary of			250
Engums Creek			750
Farrs Creek			750
Finrites Creek			500
George Lygas Creek			750
Gunderson Creek			750
Hauges Creek			750

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Independence, Hawkinsons Creek			750
Husselgards Creek			750
Ignatz Lyga Creek			750
Kilness Creek			750
Nelsons Creek			750
North Branch			750
Olsons Creek			750
Plum Creek			750
Poppies Creek			750
Roskos Creek			750
Russel Valley Creek			750
Rust Creek			750
Schaffners Creek			750
Simonsons Creek			750
Skogstad Creek			750
Slantons Creek			750
Solfests Creek			750
Travers Valley Creek			750
Uetz Creek			750
Ulbergs Creek			750
Vennis Creek			750
Wares Creek			250
Zimmers Creek			750
Iron River, Flagg River			5,000
Iron River			5,000
Spider Lake			3,000
Kimball, Bear Creek			3,000
Forbes Brook			3,000
MacKinney Creek			3,000
Ryans Brook			2,000
Tamarack Creek			3,000
La Crosse, Chipmunk Coulee Creek			500
Coon Creek			250
Lewis Valley Creek			500
Morman Coulee Creek			500
State Road Coulee Creek			250
Timber Creek			250
Ladysmith, Bear Creek			800
Clear Creek			1,600
Deer Tail Creek			2,400
Hemlock Creek			2,400
Little Weigore Creek			2,400
Mad Creek			2,400
Weigore Creek			2,400
Lancaster, Austin Branch			250
Borah Branch			250
Club Branch			500
Crow Branch			250
Day Branch			250
McPherson Branch			250
Milner Creek			250
Nathan Branch			250
Polloc Branch			500
Rains Branch			250
Spring Creek			250
Wagner Branch			250
Walker Branch			250
Williams Branch			500
Manitowoc, East Twin River			750
Herman Creek			2,300
Kromforts Creek			1,200
Spring Creek			1,800
West Twin River			750
Mauston, One Mile Creek			500
Medford, Brush Creek			900
Mellen, Bad River			4,500
Iron River			600
Merrill, Barnes Creek			2,400
Black Elder Creek			1,800
Copper River			1,800
Devils Creek			1,800
Hay Meadow Creek			1,800
Little Hay Meadow Creek			450
New Wood Creek			2,400
Pine Creek			2,625
Pine Creek, North Branch			450
Ripley Creek			1,800

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Merrill, Smith Creek			1,800
Snow Creek			225
Spring Creek			2,025
Merrillan, Arnold Creek			1,250
Cisna Creek, South Branch			250
Hayden Creek			500
Stockwell Creek			500
Van Herset Creek			250
Visnoe Creek			250
Midway, Halfway Creek			500
Jostad Coulee Creek			250
Johnson Coulee Creek			250
Long Coulee Creek			500
Spring Coulee Creek			250
Mondovi, Cranberry Creek			250
Dutch Creek			250
Ford Creek			500
Van Pelt Creek			500
Wilson Creek			500
Mount Horeb, Blue Mounds Creek			1,000
Blue Mounds Creek, branch			1,000
Blue Mounds Creek, Mount Horeb Branch			1,000
Boecks Creek			1,000
Lund Bottom Creek			1,000
Mount Vernon Creek			1,000
Noons Creek			1,000
Nashville, Lost Lake			3,000
New Lisbon, White Creek			1,000
Newry, Coon Creek			2,000
Coon Creek, branch			6,250
Kickapoo River, East Branch			1,250
Norwalk, Devils Hollow Creek			250
Morse Creek			600
Rockeman Run			400
Oconto Falls, Spring Farm Pond			500
Ontario, Brush Creek			500
Cook Creek			250
Pepin, Bogus Creek			3,400
Ell Creek			500
Little Plum Creek			1,000
Lost Creek			2,100
Porcupine Creek			1,000
Roaring River			2,400
Roaring Run			500
Readstown, Andersons Creek			500
Bishop Branch			1,000
Black Bottom Creek			1,000
Brush Run			250
Clancy Creek			250
Day Creek, East Branch			250
Downey Branch			250
Drake Branch			250
Duddle Creek			250
Elk Creek			1,250
Elk Creek Branch			500
Erkums Branch			250
Flannagan Creek			1,000
Flannagan Run, East Branch			250
Fortney Run			250
Halls Branch			250
Harrison Creek, Johnson Branch			500
Jacobson Branch			250
Johnson's spring run			250
McKinney Creek			500
McSherry Creek			250
Medthum Creek			500
Reeds Creek			250
Rogers Creek			500
Seim Branch			250
Simpson Branch			250
Siverson Creek			250
Trout Creek			1,250
Trout Creek, Wards Branch			500
Wards Run			3,000
Woodruff Spring Branch			250
Wyman Run			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Redgranite, Ash Creek			1,500
Cedar Creek			1,500
Lawn Creek			1,500
Richland Center, Melanthan Creek			1,500
River Falls, Kinnickinnick Creek			4,000
Kinnickinnick Creek, South Fork			2,400
Sauk City, Keopples Creek			1,000
Otter Creek			1,500
Sayner, Bear Creek			1,200
Plum Creek			2,400
Sheboygan Falls, Milwaukee River, North Branch			1,000
Mullet River			2,100
Onion River			3,000
Rhine Creek			800
Sparta, Ash Run			2,000
Bailey Creek			2,000
Beaver Creek			2,000
Big Creek			1,000
Cannon Valley Creek			2,000
Coles Valley Creek			2,000
Farmers Valley Creek			2,000
Fish Creek			2,000
Lions Valley Creek			2,000
Little Silver Creek			2,000
Nicols Creek			2,000
Parks Creek			400
Sand Creek			2,000
Shattuck Creek			2,000
Sias Creek			2,000
Soper Creek			2,000
Squaw Creek			2,000
Stillwell Creek			2,000
Swamp Creek			2,000
Tar Creek			2,000
Tuttle Creek			2,000
West Creek			2,000
Spring Brook, Godfrey Brook			4,600
Spring Green, Sneid Creek			1,500
Spring Valley, Bahr's spring run			250
Burghardt Creek			250
Cady Creek			250
Cave Creek			250
Eagle Spring Run			250
Eau Galle River			1,000
French Creek			250
Gilbert Creek, Middle Fork			250
Gilbert Creek, North Fork			250
Gilbert Creek, South Fork			250
Knights Creek			250
Loohns Creek			250
Lousy Creek			250
Mines Creek			250
Mines Creek, South Fork			250
Stanley, Hay Creek			900
Otter Creek			300
Swim Creek			300
Stitzer, Ball Branch			250
Beetham Branch			250
Benner Branch			250
Leggett Branch			250
Strum, Bruce Valley Creek			1,000
Superior, Big Balsom Creek			900
Empire Creek			600
State Line Creek			600
Taylor, Amundson Creek			500
Beaver Creek			500
Bentson Creek			500
Bergseth Creek			500
Colwell Creek			500
Curran Creek			750
Ellison Creek			750
Engebretson Creek			500
Erickson Creek			500
Finn Creek			750
French Creek			750
Hells Creek			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Taylor, Jermstid Creek			500
Kutcher Creek			500
Letson Creek			750
Low Creek			750
Nichols Creek			750
Olson Creek			500
Peter Coulee Creek			750
Pine Creek			750
Sharps Creek			250
Skulleys Creek			750
Sly Creek			500
Smiths Creek			250
Spauldings Creek			750
Strand Creek			250
Thompson Creek			500
Vassa Creek			500
Vincents Creek			250
Tomah, Bear Creek			3,250
Brander Creek			250
Clifton Creek			250
Coles Creek			3,000
Council Creek			3,000
Deer Creek			3,250
Dixon Creek			250
Jennings Creek			3,250
Lemonweir River, South Branch			250
Little Flora Creek			2,000
Little Silver Creek			2,250
Mill Creek			3,250
Mud Creek			3,250
Sand Creek			250
Silver Creek			250
Silver Creek, Cane Branch			250
Slaton Creek			3,000
Squaw Creek			3,000
Spring Bank Pond			250
Swamp Creek			3,000
Tar Creek			3,250
Wagner Creek			250
Tomahawk, Little Pine Creek			2,400
Troy Center, Spring Brook			2,000
Tunnel City, Tar Creek			500
Turtle Lake, Beaver Brook			900
Silver Creek			1,600
Spring Brook			300
Viola, Camp Creek			2,000
Cherry Valley Creek			2,000
Church Creek			2,000
Duck Creek			2,000
Elk Creek			2,000
Goose Creek			2,000
Harrison Branch			2,000
Jones Creek			2,000
Knapps Creek			3,000
Spring Brook			2,000
Tiny Brook			2,000
Welker Run			2,000
West Branch			3,000
Viroqua, Brookville Creek			500
Harrison Hollow Creek			250
Seas Branch			250
Wabeno, Range Line Creek, South Branch			1,800
Warrens, Dunsky Creek			500
Sand Creek			500
Wascott, Railton Creek			4,000
Spring Creek			5,000
Waukesha, Campbell Creek			1,500
Jericho Creek			1,500
Scuppernong Creek			1,500
Waupaca, Waupaca River			3,600
Wausaukee, Elbow Lake			1,000
Westby, Springdale Creek			500
Whitehall, Bruce Creek			500
Coral City Mill Pond			250
Elk Creek			1,000
Fly Creek			500
Irvin Creek			500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

BROOK TROUT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.			
Whitehall, Johnsons Creek			500
Pikes Creek			500
Plum Creek			500
Pollman Creek			500
Rumple Creek			500
Russell Creek			1,000
Sleepy Creek			500
Welch Creek			500
Whitewater, Aurelion Creek			3,000
Bradway Creek			3,000
Bloodgood Creek			3,000
Gould Creek			3,000
Spring Andrews Brook			3,000
Steele Brook			3,000
Whitewater River			3,000
Winneboujou, Bay Lake			4,000
Big Lake			3,000
Blueberry Creek			4,000
Brule River			6,000
Cutler Creek			3,000
Florence Lake			3,000
Hart Lake			3,000
Holbrook Creek			3,000
Little Brule River			4,500
Lucius Lake			3,000
Nebagamon River			4,000
Winneboujou Pond			2,000
Wonewoc, Crossman Creek			1,000
Gardner Creek			750
Woodman, Warners Creek			1,000
Wyoming:			
Aladdin, Oak Creek			4,000
Oak Creek, South Fork			400
Beulah, Crystal Springs Creek			25,000
Sand Creek and branch			15,000
Centennial, Brooklyn Lake			5,000
Deep Lake			5,000
Gap Lake			3,000
Lake Marie			3,000
Lookout Lake			5,000
Silver Lake			4,000
Cheyenne, Diamond Creek			4,500
Lone Tree Creek			600
Cody, Clear Water Creek			1,000
Crow Creek			1,000
Shoshone River, Elk Fork			1,750
Trail Creek			1,250
Greybull, Shell Creek Lakes			1,250
Lander, Willow Creek			6,500
Laramie, State Fish Commission	50,000		
Newcastle, Beaver Creek			25,000
Roberts Pond			500
Saratoga, Cedar Creek			7,500
Jack Creek			7,500
Lord Creek			10,000
Methodist Creek			7,500
North Lake Creek			6,000
North Platte River			19,500
North Spring Creek			7,500
Pass Creek			10,000
Sage Creek			10,000
South Spring Creek			10,000
Sheridan, State Fish Commission	100,000		
Sundance, Beaver Creek			15,000
Beaver Creek, East Fork			5,000
Beaver Creek, West Fork			5,000
North Redwood Creek			5,000
Spottedtail Creek			5,000
Sundance Creek			20,000
Thermopolis, Owl Creek			3,250
Japan:			
Tokyo, Imperial Household Department	20,000		
Total[a]	613,100	4,873,694	5,316,919

[a] Lost in transit 102,350 fry and 11,400 fingerlings.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

SUNAPEE TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New Hampshire:			
Lake Sunapee, Lake Sunapee		249,753	

SCOTCH SEA TROUT.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Maine:			
East Orland, Craig Pond			3,800
East Orland, Heart Pond			6,772
Total			10,572

GRAYLING.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
California:			
Sisson, State fish commission	50,000		
Colorado:			
Creede, applicant	50,000		
Denver, State fish commission	25,000		
Montana:			
Butte, applicant	75,000		
Total	200,000		

CRAPPIE AND STRAWBERRY BASS.

Disposition.	Fingerlings, yearlings, and adults.
Arkansas:	
Helena, Mississippi River	23,851
Wynne, Killone Pond	50
Colorado:	
Fort Logan, Rucker's lake	400
Pueblo, Chew's pond	300
Illinois:	
Carbondale, Andrews Lake	20
Chamness Lake	20
Ogden's lake	20
Phillips Pond	20
Whiteside Lake	20
Golconda, Lake Avalon	20
Hillsboro, Pocock Farm Lake	20
Mahomet, Sangamon River	300
Meredosia, Meredosia Bay	75
Shepherd, Sni E Carte River	160
Springfield, Culver Farm Lake	20
Waggoner, Deer Lick Pond	20
Indiana:	
Bloomington, Fulwider's pond	16
Quarry Pond	16
Corydon, Kings Cave Lake	16
Edenburg, White River, East Fork	48
Hillsboro, Beaver Lake	16
Jasper, Willow Pond	16
Madison, Big Creek	48
Reelsville, King's pond	16
Shelbyville, Brandywine River	48
Tennyson, Byers Pond	16
Lake Olentice	32
Vevay, Brown's pond	16
Iowa:	
Bellevue, Mississippi River	44,300
North McGregor, Mississippi River	14,500
Minnesota:	
Rushford, South Rushford Canal	150
Missouri:	
Birch Tree, Mirror Pond	100
Golden City, Cross's pond	100
Koshkonong, orchard company pond	250
Missouri—Continued.	
Matson, M., K. & T. reservoir	800
Neosho, Shoal Creek	600
Pierce City, Clear Creek	250
Purcell, Bradford's pond	100
Reeds, Spring River	500
Springfield, Fallin Lake	150
Thayer, Boyd's pond	200
Weaubleau, McCracken Pond	150
Nebraska:	
Falls City, Maust Bros. Spring Lake	200
New York:	
Gloversville, Mountain Lake	75
Van Dewbergs Pond	75
Woodwards Lake	75
Olean, Alleghany River	150
Oklahoma:	
Ardmore, Ardmore Rod and Gun Club Lake No. 2	200
Grove Lake	200
Invarary Pond	300
Lake Humedale	200
Loves Lake	200
Mason's pond	600
Altus, Fowler Lake	24
Anadarko, Hog Creek	36
Washita River	36
Davis, Courtney Pond	200
Eldorado, Sandy Creek	24
El Reno, Rod and Gun Club Lake	300
Enid, Spring Valley Lake	24
Frederick, Jones Pond	12
Headrick, Young's pond	12
Hinton, Cleo Lake	24
Hobart, Boxley's pond	24
Hobart Water Works Reservoir	24
Hydro, Funck's pond	190
McAllister, Cole's lake	200
Marietta, Blake's pond	100
Mountain Park, Bermuda Lake	12

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

CRAPPIE AND STRAWBERRY BASS—Continued.

Disposition.	Finger-lings, yearlings, and adults.
Oklahoma—Continued.	
Mountain View, Jones Lakes	24
Noble, Blackwell Lake	100
Tishomingo, Big Sandy Creek	250
Blue River	300
Eastwood Lake	200
Mule Lake	300
Pennington Creek	200
Rock Creek	100
South Dakota:	
Seneca, Brogan Pond	100
Tennessee:	
Hollow Rock, Holcomb Pond	100
McKenzie, Clear Lake	250
Paris, Clary's pond	100
Texas:	
Albany, Cook's pond	80
Nail's ponds	240
Archer City, Powell's lake	50
Town Pond	100
Arlington, Beckham Lakes	50
Aspermont, McBroom's pond	80
Athens, Dalrymple's pond	20
John Quincy Lake	100
Round Lake	100
Sunset Lake	60
Turtle Lake	100
Austin, Bachman and Jourdan Pond	50
Daugherty Pond	20
Dube Pond	20
Polson Pond	20
Ross Pond	20
Shoal Creek	100
Avinger, Hearn Pond	20
Ballinger, Benabedas Lake	100
Currie's pond	20
Bangs, Fitzgerald's lake	30
Fitzgerald's pond	30
Willow Lake	20
Bardwell, Wrights Lake	75
Bay City, Cleveland Lake	100
Beeville, Dougherty's pond	50
Bennetts, Bennetts Lake	50
Blossom, Bell's pond	30
Elliott's pond	30
Evans Lake	230
Fosters Pond	100
Lime Pond	50
Read Pond	50
Simmons Pond	40
Terrell's pond	100
Westbrooks Pond	30
Blooming Grove, Langston's pond	50
Bonham, Taylor Pond	100
Brady, Shuler Pond	100
Brenham, Brenham Club Lake	100
Brookesmith, Live Oak Lake	100
Bronson, Crystal Lake	50
Star Lake	50
Brownwood, Cascade Lake	80
McChristy's ponds	100
Bruceville, Clear Lake	75
Buck, Magnolia Lake	150
Burlington, Nolan's pond	50
Burnet, Cheatham's pond	30
Burton, Watson's pond	50
Caldwell, Oliver Lake	100
Canyon City, Paladora Creek	200
Terra Blanca Creek	100
Carthage, Mystic pond	60
Clarendon, Bell's lake	50
Sink Lake	50
Timber Lake	75
Celina, Lake Huron	100
Clarksville, McCoy Country Club Lake	50
Cline, Turkey Creek	200
Colorado, Forest Creek	100
Jarman Lake	50
Texas—Continued.	
Comanche, Flemming Lake	75
Harris Lake	75
Roberson's pond	60
Corsicana, Cooksey's pond	90
Kirven's pond	40
Love Lake	50
Odd Fellows Pond	75
Whitten's pond	125
Crowell, Russell's pond	50
Dale, Hurst Pond	30
Dallas, Cockrell's pond	100
Dowdy Lake	150
White Rock Lake	400
Datura, Herrings Pond	75
Del Rio, Hamilton's pond	50
Thomas Lake	100
Detroit, Caton Lake	30
Detroit Club Lakes	150
Gooch Lake	100
Guest's pond	30
Sample's pond	30
Eastland, Jones Pond	50
El Campo, Morrison's pond	50
Enloe, Hagood's pond	50
Redus Pool	25
Whiteakers Pond	50
Fairbanks, Hillendahl's pond	60
Hiltpold's pond	60
Floresville, Ewing's pond	30
Floyd, Hise Pond	40
Fluvanna, Brownings Pond No. 2	30
Fort Worth, Reynolds Lake	40
Frost, Field's pond	50
Garrison, Irwin's pond	100
Little Joe Lake	100
Germania, Mustang Draw Lake	50
Gilmer, Angle Lake	50
Douphrates Pond	75
Mackey's pond	50
Oaks Lake	200
Ginger, Emory Pond	115
Gordon, Palo Pinto Creek	100
Grandbury, Connally's pond	60
Grapeland, Darsey's pond	40
Myrtle Lake	100
Tyre Lake	50
Willow Lake	50
Wootens Lake	100
Haskell, Big Pond	25
Hughes Pond	50
Henderson, Shawnee Lake	50
Hillsboro, Hillsboro Park Lake	100
Houston, Dickson Pond	90
Hubbard, Calloway Pond	20
Chapman's pond	20
Matson Lake	40
Mayfield Pond	50
Huntington, White Perch Lake	100
Jacksonville, Club Lake	100
Park Lake	100
Jasper, Newman's pond	50
Kaufman, Barrett's pond	50
Bond's pond	50
Brush Lake	50
Burtons's pond	50
Foster Lake	50
McMullen's pond	40
Mijaalands Pond	50
Morrow Lake	60
Mulkey Lake	60
Murdock Lake	40
Park Lake	50
Shady Grove Lake	60
Sudduth's pond	50
Taylor's pond	50
Turney Pond	50
Kerrville, Bear Creek	100

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

CRAPPIE AND STRAWBERRY BASS—Continued.

Disposition.	Finger-lings, yearlings, and adults.
Texas—Continued.	
Kerrville, Guadalupe River, Burney Spring Branch	50
Indian Hollow Pond	30
Lowry Lake	40
Powerhouse Pond	60
Schreiners Pond	30
Town Creek	100
Lampassas, Collin's pond	30
Lampassas River, Sulphur Fork	100
Sulphur Creek Pond	100
Lambdin, Smith's pond	50
Wild Rose Pond	50
Lillian, Thompson Lake	75
Littig, Lake Clare	50
Lockhart, Smith's pond	50
Strawn's pond	50
Longview, Longview Club Lake	100
Minnies Lake	40
Loraine, Brownlee Lake	25
Lufkin, Brookshire's pond	50
City Reservoir	100
Lake Myriad	100
Pondexters Pond	50
Mabank, Hearn's pond	100
Mathis, Ideal Reservoir	40
Maydelle, Odom Pond	100
Meridian, Duncan Pond	40
Mertzon, Byler Creek	100
Dove Creek	100
Lopeze Creek	100
Middle Pond	100
Sherwood Creek	50
Spring Creek	100
Upper Pond	100
West Rocky Creek	100
Mexia, Hughes Pond	50
Munger's pond	100
Smith Pond	50
Midlothian, Grimes Pond	30
Mineola, Shady Pond	60
Mount Calm, Ferguson's pond	40
Mount Selman, Crawford Lake	50
Nacogdoches, Poe Lake	100
Shawnee Lake	100
Naples, Belcourt Pond	90
Navasota, Anderson's pond	30
Newcastle, Belknap Lake	50
Johnson's pond	50
Palestine, Allen Lake	100
Bear Lake	100
Blacks Lake	100
New Kirk Lake	100
Phillips Lake	100
Paris, Gordon Lake	100
Hearons Pond	40
Idlemore Lake	50
Penelope, Ender Lake	75
Pharr, Renegar's pond	75
Pittsburgh, Davis Club Lake	100
Fernadale Club Lake	200
Plainview, Slaton's pond	100
Pritchett, Spencers Lake	50
Quanah, McDonalds Lake	50
Swearingen Pond	50
Reagor Spring, Kings Lake	75
Rice, Harper's lake	50
Oak Pond	50
Richland, Edgars Pond	50
Rockdale, Randles Lake	100
Roscoe, Ohlenbusch's pond	30
Rudolph, Punta del Monte Lake	150
Sagerton, City Lake	50
Santa Anna, Robinett's pond	55
Texas—Continued.	
Santa Anna, Windmill Pond	45
San Angelo, Bridgeview Lake	100
Concho River	140
Concho River Lake	200
Hallmark's pond	50
North Concho River	100
San Antonio, Blue Wing Lake	400
San Diego, Woods Lake	75
San Marcos, San Marcos River	550
Shepard's pond	50
Seguin, Erskines Ferry Pond	50
Geronimo Creek	200
Guadalupe River	200
Long Willow Pond	50
Shamrock, Sweet Water Creek Pond	100
Snyder, Crawfish Pond	50
Johnson's pond	50
Waskom Pond	50
Sprinkle, Six Mile Lake	100
Stamford, Hughes Pond	80
Stephenville, Bosque River	100
Streetman, Milligan Pond	75
Southerland Springs, Willow Creek	50
Sylvester, City Lake	50
Farley's pond	100
Hambright's pond	100
Plum Lake	50
Terrell, Bowler Lake	50
Griffiths Lake	50
Raley's pond	40
Rose Hill Lake	50
Terrell County Club Lake	75
Waters Lake	50
Thornton, Bighill Gin Pond	50
Timpson, Wedgeworth's pond	50
Tyler, Black Fork Creek	200
Country Club Lake	100
Fielder's bridge pond	100
Head Lake	75
Lakewood Lake	100
Lindsay Lake	100
Long Lake	75
Rowland Lake	125
Shamburger Lake	50
Smith Lake	50
Smith's pond	50
Stokes Lake	100
Water Works Pond	50
Uvalde, Leona River	415
Nueces River	415
Vernon, Condon Spring Lake	50
Waco, Days Lake	100
Hollands Pond	110
Phillips Pond	50
Standefer's pond	50
Walnut Springs, Stinebaugh Lake	80
Water Valley, Club Lake	100
Irrigation Lake	100
North Concho River	100
Weatherford, Sanchez Lake	50
Webster, Burton's pond	90
Wills Point, Fields Lake	50
Lake View	50
Lake Jamison	40
Winnsboro, Rosalee Pond	40
Wortham, Lake Manning	75
Cedar Lake	40
West Virginia:	
Berkeley Springs, Cacapon Creek	85
Buckhannon, Buchannon River	85
Shepherdstown, Potomac River	1,962
Total [a]	117,303

[a] Lost in transit, 400 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

ROCK BASS.

Disposition.	Fingerlings, yearlings, and adults.
Alabama:	
Mobile, Black Fork Creek	100
Nauvoo, Hunter's pond	100
Arkansas:	
Gurdon, Abbott's pond	500
Helena, Mississippi River	2,015
Mammoth Spring, Spring River	300
Georgia:	
Atlanta, Kimballville Lake	75
Ossahatchie, Ossahatchie Creek	50
Illinois:	
Anna, Lufkins Ponds	300
Chester, Gant Ponds	400
Herrin, Railway Lake	200
Thomasville, Northwest Pond	200
Indiana:	
Austin, Oard Springs Lake	100
Batesville, Busch Pond	150
Quarry Pond	150
Bloomington, Letitia Ponds	150
Quarry Pond	100
Camden, Fout's pond	150
Chrisney, Sibrel's pond	100
Elkhart, Simonton Lake	800
Greenfield, Boyad Pond	100
Indianapolis, Laycock Lake	150
Jeffersonville, Government Pond	200
Littles, Miller's pond	200
Logansport, Oakridge Pond	200
Sulphur Spring Pond	100
Memphis, Silver Creek	500
Oakland City, Water Lily Pond	150
Osgood, Benham's ponds	200
Ripley Pond	100
Portland, Nixon Gravel Pond	100
Red Key, Fishbacks Pond	150
Rochester, Pleasant Valley Fish Pond	150
St. Paul, Hendrickson's pond	100
Sardinia, Tremain's pond	150
Sheridan, Dunbar Lake	200
Somerville, Martin's pond	200
Sunman, Johnson's pond	150
Schneider's pond	100
Iowa:	
Kirkman, Happy Valley Pond	200
Manchester, Maquoketa River	5,100
Kansas:	
Comiskey, Troutman Pond	200
Edna, Kendall's spring pond	300
Fredonia, Rainbow Creek	750
Junction City, Country Club Lake	500
Lehigh, Clear Pond	200
Kentucky:	
Bank Lick, Lampton's pond	150
Berea, Moore's lake	150
Burnside, Otter Creek	500
Campbellsburg, Scott's pond	100
Crayne, Blue Fountain Pond	100
Donerail, Home Pond	150
Erlanger, Blankenbeker's pond	150
Locust Grove Pond	200
Fort Garrett, Oaklands Pride Pond	100
Foster, Miller's lake	150
Franklin, Cavett's pond	150
Terrapin Creek	300
Fredonia, Crider's pond	200
Grayson Springs, Witten's pond	100
Hodgenville, Middleton's pond	200
Lebanon, Wood Hill Pond	300
Maysville, Williams Lake	150
Moreland, Bonnie Lake	200
Paris, Burke Pond	150
Toohey's pond	150
Princeton, Osborne's lake	400
Richmond, Comb's pond	100
Pioneer Pond	150
Kentucky—Continued.	
Rocky Hill, Oller's pond	200
Rowletts, Brunson Pond	100
Trenton, Waller's pond	150
Versailles, Camden's pond	200
Walton, Lesch's pond	200
Wilson's pond	200
Louisiana:	
Ponchatoula, Howe's pond	100
Maryland:	
Baltimore, McKinstry's pond	200
Miller's pond	300
Landover, Eccles Pond	200
Sandy Hook, Virt's pond	400
Severn, Severn Ponds	1,000
Mississippi:	
Amory, Vaughn's pond	100
Bay St. Louis, Perrin's pond	100
Cuba, Wilder's pond	100
Guntown, Willow Lake	100
Landon, Albrecht Pond	100
Macon, Mud Lake	100
Pheba, Gosa's pond	100
Starkville, Christopher's pond	100
Valley, Brumfield's pond	100
Wesson, Bush Pond	100
West Point, Duke's pond	100
Sandy Lake	100
Stock Pond	100
Missouri:	
Lebanon, McNeils Spring Pond	200
Mansfield, Echo Dell Pond	300
Neosho, Hearrell Branch	6,900
Spring Lake	300
Newburg, Little Piny Creek	1,000
Parker Pond	500
Richards, Richardson's pond	300
Rolla, Big Dry Fork Creek	1,000
Cave Spring Creek	1,000
Little Dry Fork Creek	1,000
Waltz Creek	500
Weldon Springs, Spring Lake	300
Nebraska:	
McCook, Leland's pond	150
New York:	
Poughkeepsie, Lyon's lake	325
Walden, Wallkill River	400
North Carolina:	
Elkin, Bryant's pond	150
Swain's pond	150
Four Oaks, Lassiter's pond	150
Goldsboro, Tara Farm Pond	300
High Point, Beaufort Lake	100
Kinston, Jericho Pond	1,000
Marston's lake	300
Kittrell, Grissom Pond	150
Richfield, Rowland's pond	200
Thomasville, Amazon Reservoir	100
Ohio:	
Cumminsville, Willow Pond	200
Oklahoma:	
Atoka, Hiwana Creek	200
Elk City, Murphree's pond	75
El Reno, Grigsby Pond	300
Enid, Boles Pond	75
Forney, King's lake	150
Hitchcock, Schenks Pond	75
Hydro, Funck's pond	400
Mangum, Wright Pond	75
Meridian, Johnson's pond	300
Milburn, Blue River	600
Rocky, Wine's pond	75
Stuart, Bowers Pond	150
Yukon, Cow Creek Pond	200
Shill Creek Pond	200

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

ROCK BASS—Continued.

Disposition.	Fingerlings, yearlings, and adults.
South Carolina:	
Easley, Leslie's pond	200
Tennessee:	
Baxter, Massa's pond	200
Buffalo, Petty Pond	200
Chattanooga, Lake Lookout	800
Simpson's pond	200
Clinton, Moore's pond	200
Franklin, German Pond	300
Gallatin, Perlite's pond	250
Hollow Rock, Groom's pond	200
Phillips's pond	100
Jena, Waterloo Stock Pond	200
Knoxville, Hensley's pond	200
Lewisburg, Snake Creek Valley Lake	250
Mount Pleasant, Sugar Creek, West Fork	800
Murphreesboro, Howse's pond	100
Orlinda, Willow Pond	200
Palmyra, Lake Richard	150
Ridgetop, Derseweh's pond	100
St. Bethlehem, Slayden's pond	200
Shawanee, Snaveley's pond	200
Springfield, Farthing's pond	250
Tazewell, Parker Pond	200
Tennessee City, Willow Pond	300
Tullahoma, Nabring's pond	250
Whitwell, Sequatchie River	750
Texas:	
Alto, Liles Lake	40
Asherton, Schumann's pond	20
Austin, Hielscher Pond	20
Avinger, Sarber Lake	125
Bangs, Strange's pond	20
Bullard, Glasscock's lake	50
Campbell, Baughman's pond	20
Cumby, Pearcy's pond	20
Detroit, Club Pond	20
Ward Pond	60
Franklin, Fulton-Love Lake	60
Gainesville, Rock Creek	100
Spring Creek	100
Henderson, Black Jack Lake	40
Brown Lake	100
Parker's pond	30
Houston, Weiner's pond	60
Hubbard, Mayfield Pond	40
Texas—Continued.	
Hubbard, Old Jones Pond	50
Jourdanton, Galloway's pond	25
Preston's pond	25
Kerrville, Live Oak Pond	30
Lampasas, Anderson's pond	50
Phelan's pond	30
Yeager Pond	40
Lindale, Lone Pine Pond	30
Lyons, Jahns Pond	20
Mount Calm, Milner's pond	90
Paris, Lewis Pond	50
Pittsburg, Ferndale Club Lake	165
Rogers, Etter Lake	40
Rusk, Dickinson's pond	100
San Angelo, Stout's Pond	70
Santa Anna, Byrds pond	30
Cobb's pond	20
Mountain Home Lake	20
Williams Pond	80
Sherman, County Farm Pond	30
Taylor, Schwenker's pond	15
Winsboro, Cypress Pond	30
Virginia:	
Adsit, Raney's pond	200
Bedford City, Dennis Pond	150
Benhams, Greens Creek	600
Charlottesville, Hartman's pond	600
Fall Creek, Hatcherson's pond	1,100
Farmville, Ligon's pond	200
La Crosse, Vaughan's pond	400
Milford, Cool Lake	500
Tacoma, Blair's pond	300
Troutville, Harvy Pond	200
Richmond, Falling Creek	800
Holly Spring Lake	400
Redford's pond	800
Scottsville, Jones Pond	300
South Boston, Oakland Pond	200
Warren, Gibb's pond	250
Woodlane, Cedar Pond	250
West Virginia:	
Berkeley Springs, Cacapon Creek	500
Shepherdstown, Potomac River	4,502
Woodland, Yoho's pond	435
Total [a]	65,642

WARMOUTH BASS.

Alabama:	
Maxwell Switch, Winston Lake	150
Georgia:	
Midland, Midland Lake	125
Maryland:	
Great Falls, Potomac River	2,346
Mississippi:	
Harriston, Richmond Hill Pond	200
Valley, Brumfield's pond	150
Total	2,971

[a] Lost in transit, 625 fingerlings.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

SMALL-MOUTH BLACK BASS.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Arkansas:		
Batesville, Wagon Wheel Creek		120
Farrell, Farrell Lake		240
Mammoth Spring, Warm Fork Creek		350
Pocahontas, Eleven Point River		240
Wayne, Killone Pond		50
Connecticut:		
Middletown, Jobs Pond		100
Norwich, Garden Lake		100
Oxoboxo Lake		100
West Cornwall, Cream Hill Lake		75
West Redding, Spring Lake		75
Winsted, Simonds Pond	1,500	
Illinois:		
Antioch, Lake Marie		200
Barrington, Lake Zurich		200
Grays Lake, Drusses Lake		200
Joliet, Du Page River	5,000	350
Kankakee, Kankakee River	4,000	
Vincennes, Robison's lake		500
Wilmington, Kankakee River	3,000	350
Indiana:		
Advance, North Pond		300
Anderson, White River		1,200
Angola, Bass Lake	1,000	
Lake Gage	2,000	
Lake James	2,000	
Lake Jimerson	2,000	
Marsh Lake	2,000	
Pigeon Lake	2,000	
Snow Lake	2,000	
Attica, Shawnee Creek		600
Carmel, Cool Creek		500
De Pauw, Blue River		800
Greencastle, Big Walnut Creek		600
Little Walnut Creek		600
Indianapolis, Eagle Creek		800
Fall Creek		3,100
White River		2,300
Lebanon, Shannon Gravel Pond		250
Liberty, Whitewater River, East Fork		1,500
Ligonier, Diamond Lake	2,000	
Eagle Lake	2,000	
New Albany, Silver Creek		750
Terstegge Pond		750
Noblesville, Cicero Creek		600
Richmond, Whitewater River, Greens Fork		2,500
Shelby, Kankakee River	2,000	
Veedersburg, Coal Creek		2,300
Vistula, Hunter Lake	1,000	
Williamsburg, Greens Fork Creek		1,500
Kansas:		
Bonner Springs, Lake of the Forest		250
Kentucky:		
Cadiz, Birds Creek		1,200
Caseys Creek		1,200
Donaldson Creek		1,200
Dyers Creek		1,200
Little River		1,200
Muddy Fork Creek		1,200
Sinking Fork Creek		1,200
Clermont, Echo Lake		750
Covington, Fort Mitchell Lake		750
Kentucky—Continued.		
Danville, Dix River		900
Hanging Fork Creek		900
Knob Lick Creek		900
McRoberts Pond		900
Rolling Fork Creek		1,800
Elkhorn Station, Elkhorn River		600
Georgetown, Elkhorn River		750
Hopkinsville, Lake Tandy		600
Little River		1,200
Lawrenceburg, Salt River		400
Sherman, Sherman Lake		750
Springfield, Springfield Reservoir		750
Waynesburg, Buck Creek, West Fork		750
Maine:		
Belgrade, Long Lake	2,000	
Bridgton, Highland Lake	2,000	
Kittery Junction, Folly Pond	1,500	
Waldoboro, Medomak River	2,000	
Maryland:		
Frederick, Monocacy River		50
Great Falls, Potomac River		4,450
Hagerstown, Antietam Creek		50
Phoenix, Great Gunpowder River		75
Massachusetts:		
Beverly Farms, Gravel Pond	1,500	
Easthampton, Nashawannuck Pond	1,500	
Great Barrington, Lake Garfield		150
North Dana, Lake Neesaponsett	1,500	
Montserrat, Beaver Pond	1,500	
Russell, Westfield River	2,000	
Stockbridge, Housatonic Lake		75
Webster, Lake Chaubunagungamaug	1,500	
Michigan:		
Alma, Pine River	2,000	
Alpena, Beaver Lake	2,000	
Bangor, Scott Lake	2,000	
Bellaire, Clam Lake	2,000	
Grass Lake	2,000	
Brighton, Mont Lake	1,000	
Cassopolis, Diamond Lake	2,000	
Cass Lake, Cass Lake	4,000	
Charlevoix, Pine Lake, South Fork	2,000	
Clarion, Walloon Lake	3,000	
Clyde, Melvin Pond	1,000	
Edwardsburg, Eagle Lake	2,000	
Flushing, Allen Lake	1,000	
Grayling, Portage Lake		400
Hastings, Bump Lake	2,000	
Carters Lake	2,000	
Head Lake	2,000	
Leech Lake	2,000	
Long Lake	2,000	
Middle Lake	2,000	
Pentwater Lake	2,000	
Pine Lake	2,000	
Podunk Lake	2,000	
Tanner Lake	2,000	
Tilson Lake	2,000	
Wall Lake	2,000	
Highland, Dunham Lake	2,000	
Hillman, Jackson Lake	1,000	
Rush Lake	2,000	
Valentine Lake	2,000	

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

SMALL-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Michigan—Continued.		
Hillsdale, Baw Beese Lake	2,000	
Howell, Pete Lake	1,000	
Jackson, Ackersons Lake	1,000	
Lower Spring Arbor Lake	2,000	
Jones, Bear Lake	1,000	
La Rocque, Lost Lake	1,000	
Long Lake, Cranberry Lake	2,000	
Manitou Beach, Devils Lake	2,000	
Milford, Round Lake	2,000	
Mount Pleasant, Chippewa River	2,000	
Newaygo, Emerald Lake	4,000	
Kimball Lake	1,000	
Pickerel Lake	1,000	
Sylvan Lake	1,000	
New Richmond, Gosshorn Lake	2,000	
Oden, Crooked Lake	2,000	
Owosso, Shiawassee River	2,000	
Pellston, Douglas Lake	2,000	
Pentwater, Pentwater Lake	2,000	
Rose Center, Buckhorn Lake	1,000	
Homes Lake	1,000	
Marl Bed Lake	1,000	
Poor Lake	1,000	
Taylor Lake	1,000	
St. Johns, Merle Beach Lake	2,000	
Traverse City, Boardman Lake	2,000	
Walled Lake, Walled Lake	2,000	
Mississippi:		
Corinth, Grassy Lake		750
Missouri:		
Mount Vernon, Big Spring Creek		200
Seneca, Sycamore Creek		250
Nebraska:		
Omaha, Lake Nakomis		300
New Hampshire:		
Berlin, Head Pond		100
Claremont, Crescent Lake	1,500	
Wentworth, Baker Ponds	3,000	
West Rindge, Monomonac Lake	1,500	
New Jersey:		
Alloway, Hitchner's mill pond		100
Asbury Park, Sunset Lake		375
Boonton, Decker Lake		250
Hampton, Kinbal Lake		450
White Lake		450
Netcong, Spring Meadow Lake		300
Sewell, Sunset Lake		150
New York:		
Addison, Canisteo River		300
Tuscarora River		1,500
Binghamton, Sky Lake		450
Esopus, Kells Lake		300
Hammondsport, Lake Henko		3,000
Schenectady, Mariaville Pond		450
Wayland, Loon Lake		2,850
North Carolina:		
Hickory, Henry River		200
Hope Mills, Little Rockfish Creek		300
Ohio:		
Alexandria, Raccoon Creek		600
Bradford, Greenville Creek		600
Tuckers Creek		800
Columbus, Alum Creek		600
Big Walnut Creek		600
Black Lick Creek		600
Deer Creek	3,000	800
Ohio—Continued.		
Columbus, Little Darbey Creek		600
Dayton, Klings Lake	2,000	
Fayette, Deer Creek	2,000	
Gambier, Kokosing River		600
Germantown, Big Twin Creek		800
Granville, Brushy Fork Creek		500
Dry Creek	2,000	
Raccoon Creek	2,000	600
Ramp Creek	2,000	
Howard, Kokosing River		600
Tiffin, Sandusky River	4,000	800
Urbana, Buck Creek	4,000	
Mad River	4,000	
West Alexandria, Twin River		800
West Carrollton, Miami River	4,000	
Winton Place, Lake Dot		250
Pennsylvania:		
Bedford, Juniata River, Raystown Branch		450
Bloomsburg, Little Fishing Creek		450
Brookdale, Durwent Water Lake		650
Quaker Lake		450
Bushkill, Forest Lake		482
Chambersburg, Conococheague Creek		75
Denver, Cocalico Creek		250
Swamp Creek		250
Uibels Run		250
Vera Cruz Run		250
Hawley, Big Pond		450
Hollidaysburg, Dunnings Creek		450
Hollidaysburg, Frankstown Branch		450
Hollidaysburg, Juniata River		450
Hollidaysburg, Juniata River, Frankstown Branch		600
Hosensack, Hancock Pond		250
Jonestown, Swatara River		250
Kratz, Kratz Pond		250
Lebanon, Bimayles Pond	3,000	
Bohr's pond	3,000	
Grays Pond	3,000	
Klines Pond	3,000	
Levans Pond	3,000	
Little Swatara Creek	3,000	
Mish's pond	3,000	
Raccoon Creek		250
Stoevers Mill Pond	3,000	
Waterhouse Lake	3,000	
Weidman Pond	3,000	
Lehighton, Pohocopo Creek		450
Ligonier, Lake Marie		300
Mauch Chunk, Lake Harmony		450
Meadville, Conneaut Lake		250
Cussewago Creek		300
French Creek		450
Mount Wolf, Big Conewago Creek		100
Myerstown, Swatara Creek		250
Neshaminy Falls, Neshaminy Creek		250
New Ringgold, Rausch Dam		250
Palm, Hosensack Creek Pond		250
Perkiomen Creek		250
Philadelphia, Darby Creek		483
Reading, Tulpehocken Creek		375

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

SMALL-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Pennsylvania—Continued.		
Rowlands, Lake Teedyuskung		450
Saegertown, French Creek		300
Shenks Ferry, Susquehanna River	15,000	
Uniontown, Taylor Reservoir		450
Wilkes-Barre, Nuangola Lake		450
Williamsburgh, Juniata River, Frankstown Branch		750
Williamsport, Elk Lake		450
Rhode Island:		
Wakefield, Silver Lake	1,500	
South Carolina:		
Columbia, Hamptons Creek		100
Tennessee:		
Cleveland, Lake Wildwood		400
Columbia, Dedmans Pond		900
Denver, Trace Creek		1,400
High Cliff, Clearfork River		400
McEwen, Hurricane Creek		1,500
McKenzie, Clear Lake		500
Tennessee Ridge, South Cross Creek		300
Tullahoma, Big Duck River		400
Lake Calanthe		400
Waverly, Big Richland Creek		1,500
Hurricane Creek		2,100
Trace Creek		1,500
Vermont:		
Averill, Wallis Pond		109
Bennington, Big Woodford Pond		100
Danby, Danby Pond		100
Danville, Keeser Pond	3,000	
Mud Pond	3,000	
Joe's pond, Lake St. Joseph	4,000	
Lyndonville, Bean Pond	4,000	
Center Pond		500
St. Albans, Lake Champlain		100
St. Johnsbury, Black River		100
Vermont—Continued.		
South Vernon, Perry Pond	1,500	
Wanamakee Lake	1,500	
Virginia:		
Ashby, Shenandoah River	15,000	
Bess, Potts Creek		625
Clifton, Bull Run		450
Danville, Clark's pond		200
McGuire's pond		200
Fredericksburg, Po Creek		450
Guinea, Jones Lake		300
Lynchburg, Odd Fellows Home Pond		125
Providence Forge, Mirror Lake		625
Richmond, Anderson's pond		625
Jones Pond		625
Roxbury, Cosby's pond		625
Savage's pond		625
Woodstock, Narrow Passage Creek	10,000	
Wytheville, Tates Run	2,500	
West Virginia:		
Charleston, Elk River	25,000	
Elkins, Tygarts Valley River	15,000	
Elm Grove, Big Wheeling Creek	15,000	
Grafton, Tygarts Valley River	10,000	
Morgantown, Dunkard Creek	24,000	275
Pennsboro, Hughes River, North Fork	18,000	
Raleigh, Piney Creek	20,000	
Romney, Potomac River, South Branch		750
Sistersville, Middle Island Creek	10,000	
Wellsburg, Buffalo Creek	15,000	
Total [a]	454,500	107,099

LARGE-MOUTH BLACK BASS.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Alabama:		
Alexander City, Elkhatchie Creek		500
Andalusia, Gunter's pond		1,250
Ashby, Six Mile Creek		500
Birmingham, Central Water Works Reservoir		100
Oliver Lake		500
Scotts Branch Pond		500
Brent, Haysop Creek tributary		125
Calcis, Kellys Creek		1,000
Chandler Springs, Talladega Creek		500
Geiger, Gilbert's pond		200
Irondale, Addington's mill pond		1,500
Lanett, Poplar Spring Pond		100
Notasulga, Vaughn's mill pond		500
Pyriton, Pace's lake		500
Sanford, Henderson's pond		625
Jeter's pond		625
Selma, Alligator Pond		500
Blochs Branch		500
Boggs Pond		500
Alabama—Continued.		
Brown's pond		1,000
Hall's pond		500
Turner's pond		500
Vaughn Pond		500
Sylacauga, Crooked Creek		500
Tallassehatchie Creek		500
Weathers, Talladega Creek		750
Arkansas:		
Antoine, Meek's pond		300
Arkadelphia, Caddo River		250
Ouachita River		250
Banks, Smith's pond		220
Blevins, Austin's pond		300
Camden, Mustin Lake		1,800
Eldorado, Mason's pond		100
Mathews Lake		330
railway company's lake		330
Elliott, Yarbrough's pond		100
Emerson, Bynum's pond		270
Graysonia, Antoine River		750
Gurdon, Abbott's pond		180
Haynie's pond		250
Hardy, North Big Creek		75
Helena, Mississippi River		13,472
Hope, Crystal Springs Lake		270

[a] Lost in transit, 150 fingerlings.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Arkansas—Continued.		
Hope, Pleasure Lake		1,030
Junction City, Mary Neal Pond		220
Lake Village, Lake Chicote		160
Lonoke, Chenault's pond		200
Magnolia, Pittmon & Wilson Pond		270
Malvern, Ouachita River		360
Mammoth Spring, Tracy Creek		500
Warm Fork River		6,000
Murphreesboro, Prairie Creek		1,200
Pine Bluff, Pine Log Lake		200
Taylor's lake		120
Pocahontas, Eleven Points River		320
Scotts Old River		1,000
Texarkana, Bronson Plantation Pond		180
Warren, Saline River		160
Whelen Springs, Measels Pond		200
Wilmot, Lake Enterprise		80
Womble, Bell Pond		300
Caddo River		300
Caddo River South Fork		200
Huddleston Creek		200
Lick Creek		200
Ouachita River, South Fork		200
Polk Creek		200
Wynne, Killone Pond		45
Colorado:		
Alamosa, Big Slew Lake		225
Head Lake		225
San Luis Lake		225
Spring Lake		225
Boulder, Ballar Lake		135
Beasley Lake		225
Boulder Country Club Lake		225
Budd Reservoir		135
Hayden Lake		232
Hygiene Lake		300
Denver, Cooper Lake		89
Dolores, Dolores River		225
Fort Logan, Ruckers Lake		525
Grand Junction, Grand River		275
La Jara, Flintham's ponds		150
Longmont, Clear Lake Reservoir		225
Highland Reservoir		225
Pueblo, Chew's pond		210
Little Fountain Lake		45
Teller Reservoir		21
Silverton, Molas Lakes		450
District of Columbia:		
Washington, Potomac River		331
Florida:		
Florence Villa, Lake Lucerne		100
Mohawk, Lake Tangerine		100
Orange City Junction, Buckeye Lake		100
Tampa, Cow Horn Lake		100
Ruby Lake		100
Winter Garden, Reeves Pond		100
Winter Park, Lake Maitland		100
Lake Virginia		100
Georgia:		
Americus, Flint River		1,000
Kinchafoonee Creek		1,000
Muckalee Creek		1,000
Atlanta, Clara Meer Lake		1,000
Grant Park Lake	1,000	
Lakewood Lake		2,000
Lake Magnolia		100
Georgia—Continued.		
Atlanta, Nances Creek		250
Piedmont Park		1,000
Ponce de Leon Park Lake	1,000	
Spring Lake		150
Taylor's lake		100
White City Park Lake	1,000	
Austell, Austell's pond		500
Baxley, Brown's pond		100
Brewton, Railroad Pond		1,000
Buena Vista, Halley's pond		500
Helm's pond		500
Parker's pond		500
Taylor's pond		500
Colliers, Willow Branch Pond		100
Covena, Durden's pond		125
Ellaville, Buck Creek		1,000
Forest Park, Lake Forest		100
Greenville, Hill's pond		100
Gough, Buckhead Pond		500
Griffin, Barnes Pond		1,250
Hampton, Stone's pond		100
Hawkinsville, Fountain's mill pond		1,000
Jonesboro, Betts Pond		100
Flint River		100
McCollum, Coggin's pond		100
Machen, Wamesley's pond		35
Midland, Eiola Pond		500
Millen, Buckhead Creek		1,000
Redd's pond		305
Montezuma, Peed's mill pond		1,000
Norristown, Mule Pen Creek		1,000
Oglethorpe, Wicker Pond		500
Pomona, Bermuda Lake	1,000	
Renfroes, Lane Pond		500
Reynolds, Horse Creek		1,000
Goodwin's pond		500
Shiloh, Anderson's pond		550
Stone Mountain, McCurdy Pond		500
Talbotton, Adams Pond	500	
Black's pond	500	
Dennis Pond		500
Leonard's pond		500
Perryman's pond		500
Winchester, Felton Mill Pond		1,000
Woodbury, Gilbert's pond	500	
Illinois:		
Algonquin, Fox River		625
Antioch, Echo Lake		375
Atlanta, Kickapoo Creek		400
Barrington, Bangs Lake		250
Lake Zurich		400
Benton, Blakes Pasture Pond		250
Moores Pond		200
Bloomington, Heafers Lakes		400
Carbondale, Caldwell's lake		150
Cary, Highland Lake		200
Carlinville, Rinoker Lake		400
Carrollton, Elm Grove Pond		400
Coffeen, Crites Pond		100
Collinsville, Lake Geneva		200
Coulterville, Illinois Central R. R. Pond		200
Downers Grove, Salt Lake		400
Elgin, Fox River		1,350
Everett, Armours Lake		600
Franklin, Chicago Burlington & Quincy Reservoir		200
Freeport, Yellow Creek		625
Grand Chain, Reicherts Pond		350
Grays Lake, Druce Lake		400
Gages Lake		375
Taylors Lake		375

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Illinois—Continued.		
Harrin, Coal Belt Lake		150
Railway Lake		150
Hillsboro, Arney's pond		50
McDavids Pond		400
Seymour Fishing Club Lakes		200
Woodland Home Lake		50
Hinsdale, Salt Creek		1,100
Jacksonville, Packing company pond		200
Kewanee, Glen Oak Park Lake		150
Windmont Park Pond		400
Litchfield, Chautauqua Lake		600
Lockport, Rock Lake		250
Mahomet, Sangamon River		500
Marine, Marine Reservoir		250
Mascoutah, Lincoln Lake		200
Mattoon, Mattoon Waterworks Reservoir		500
Meredosia, Meredosia Bay		60
Miles Station, Walnut Pond		200
New Burnside, Caspers New Pond		100
Rockefeller, Diamond Lake		375
Round Lake, Fish Lake		125
Round Lake		125
Shepherd, Sni E Carte River		100
Sparta, Illinois Southern Ry. Lake		300
Sterling, Rock River		150
Thomasville, Thomas Lake		150
Thornton, Thornton Pond		600
Tiskilwa, Illinois and Mississippi Canal		300
Waggoner, Deer Lick Pond		100
Wilmington, Kankakee River		250
Iowa:		
Bellevue, Mississippi River		13,034
Boone, Des Moines River		2,000
Harlan, White's pond		125
Ida Grove, Todd's pond		100
Marshalltown, Iowa River		425
North McGregor, Mississippi River		3,725
Onawa, Blue Lake		400
Percival, Opossum Lake		125
Pierson, Davis Pond		100
Stanton, Larson Pond		125
Kansas:		
Baileyville, Horseshoe Pond		300
Blue Rapids, Big Blue River		450
Little Blue River		450
Bonner Springs, Lake of the Forest		250
Chanute, Welda Reservoir		300
Cuba, Beneda's pond		200
Eureka, Carter's pond		100
Edwards Lake		300
Spring Creek		300
Holton, Rafter's lower pond		450
Kansas City, Idlewild Lake		200
Kingman, Brown's Lake		100
City Club Pond		300
Connor's pond		100
Kling, cement company lake		900
Lenexa, Lake Killarney		200
Lyndon, Salt Creek		300
Manhatten, Country Club Lake		100
Rocky Ford Creek		250
Marion, Clear Creek		300
Middle Creek		450
South Cottonwood Creek		450
Kansas—Continued.		
Medicine Lodge, Best's pond		450
Currie Pond		300
Elm Lake		300
Fryingpan Lake		300
Old Creek Lake		450
West Lake		300
Wilson's pond		100
Mound City, Little Sugar Creek		450
Mullinville, Middle Kiowa Creek		300
Pittsburg, Meadowbrook Ponds		466
Nevius Pond		233
Wabaunsee, Brown's pond		100
Wamego, Rock Creek		450
Kentucky:		
Flemingsburg, Dudley's pond		100
Greensburg, Big Brush Creek		75
Clover Lick Creek		75
Green River		75
Johns Creek		75
Little Brush Creek		75
Little Russell Creek		75
Meadow Creek		75
Pitman Creek		75
Russell Creek		375
Shiveley's pond		75
Guthrie, Linebaugh's pond		200
Taylor's big pond		200
Louisville, Ackerman's pond		400
Burford's pond		800
Hargersheimer Pond		400
Park View Lake		400
Munfordville, Carden's pond		400
Rowletts, Runnell's pond		400
Garvin Pond		400
Hardyville Lake		400
Louisiana:		
Bonita, Bonne Idee Lake		100
Calhoun, Station Lake		300
Wisner, Anderson's ponds		440
Gilberts Pond		220
Hick's pond		70
Lewis Pond		110
Shipp's pond		220
Michigan:		
Birch, Three Lake		200
Crystals Falls, Holmes Lake		210
Delaware, Beaver Lake		325
Bete Grise Bay		375
Dur Lake		375
Iron River, Lake Fifteen		150
Ishpeming, Lake Laurie		210
Kenton, John Brown Lake		210
Mandan, Breakfast Lake		375
Lake Addie		375
Schlatter Lake		375
Pentoga, Chicagon Lake		280
Watersmeet, Katherine Lake		120
Mississippi:		
Columbus, Alligator Lake		200
Lake Dotherow		200
Tombigbee River		400
Electric Mills, Electric Lake		150
Lauderdale, Lakeview Pond		150
Macon, Connor Lake		150
Eilano Ponds		300

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Mississippi—Continued.		
Macon, Holbergs Pond		150
Howards Lake		150
Poplar Lake		150
Muldon, Ivy's pond		200
Okolona, Cook's pond		200
East Lake		200
Scooba, Adams Pond		200
Ashford Pond		200
Shuqualak, Anderson Pond		300
Bardwell Place Pond		150
Bell Pond		150
Bethany's pond		150
Constantine Pond		150
Davis Pond		150
Verona, Walkers Pond		200
West Point, Grove Lake		200
Harmon Lake		200
Home Lake		200
Lake Tybee		600
Titus Pond		200
Watkins Pond		400
Westbrooks Pond		200
Missouri:		
Birch Tree, Current River, Jacks Fork		150
Bridgeton, Edrus Lake		300
Cassville, Flat Creek		450
Chicopee, Current River		300
Clinton, Artesian Lake		200
Fish Lake		200
Columbia, Lake Dutcher		450
Deepwater, Dickey's lake		200
Excelsior Springs, Craven Lake		150
Wales Lake		150
Greenfield, Turnback River		650
Holmes Park, Bass Lake		150
Kansas City, Fairmont Park Lake		685
Lamar, Spring River, North Fork		600
Marshall, Martins Lake		200
Mexico, Burlington Lake		450
Mexico Waterworks Lake		450
Railroad East Lake		450
Ozark, Finley River		200
Parkville, Emily Heights Pond		150
Pendleton, Lake Farm Pond		600
Seneca, Big Lost Creek		200
Sullivan, Lake View		150
Vandalia, Spencer Creek		300
Webb City, Center Creek		250
West Belton, Mahan Pond		150
West Line Prospect Hill Lake		150
West Plains, Crites Pond		150
Nebraska:		
Arcadia, Middle Loup River		500
Falls City, Maust Brothers Spring Lake		375
Imperial, Frenchman River		375
Lodge Pole, Lodge Pole Creek		500
McCook, Kelley Lake		250
North Platte, Pawnee Springs Lake		100
St. Paul, Spring Lake Creek		100
Nevada:		
Ely, Yelland Lake		150
New Mexico:		
Vermejo Park, Bartlett Lake		375
New York:		
Addison, Canisteo River		450
Altmar, Black Pond		120
Hendersons Pond		120
New York—Continued.		
Altmar, Long Pond		120
Sheridan Pond		120
Auburn, Owasco Lake		240
Binghamton, Chenango River		150
Susquehanna River		225
Clayton, St. Lawrence River		720
Clifton Springs, Canandaigua Creek		120
Eaton, Eaton Reservoir		120
Gloversville, Caroga Lake		180
Mountain Lake		180
Greene, Chenango River		225
Echo Lake		225
Homer, Skaneateles Lake		120
Ithaca, Cayuga Lake		300
Johnstown, Canada Lake		120
Green Lake		120
Lilly Lake		120
Otter Lake		120
Stewart Lake		180
Stuik Lake		120
West Lake		120
Lisle, Otselic River		120
Lockport, Eighteen Mile Creek, East Branch		120
Gravel Creek		80
Red Creek		120
Norwich, Chenango Lake		225
Paul Smiths, Osgood Lake		180
Salisbury, Eaton Pond		120
Saranac Inn Station, Upper Saranac Lake		120
Williamstown, Panther Lake		180
North Carolina:		
Asheville, Fernihurst Pond	750	
Biltmore, Biltmore Lake	1,000	
Jones Pond	750	
Bonlee, Bear Creek Pond		50
Corapeake, Jones Mill Pond	600	
Durham, Eno Run		500
Earl, Broad River Pond		200
Elkin, Chatham Lake		150
Elkin Creek		150
Hendersonville, Allen's pond	750	
Highland Lake	750	
Hillside Park Lake	750	
Lake Brevard	1,000	
Lake Wajaw	1,500	
Lilly Pond	750	
Hillsboro, Berry Pond		600
Kings Mountain, Anna Cotton Mills Pond		150
Littleton, Granite Pond		400
Lucama, Lucas Pond		400
Newsams Pond		400
Monroe, Sparrow Hawk Farm Pond		100
Spring Lake		100
Oxford, Cozart's mill pond		600
Grassy Pond		800
Lake Caldwell		500
Pine Bluff, Aberdeen Creek		250
Raleigh, Beaver Dam Pond		500
Hintons Pond		400
Ridgeway, Smith Creek		400
Oklahoma:		
Altus, Bitter Creek		150
Cobb Lake		150
Lake Navajo		225
Stinking Creek		150

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Oklahoma—Continued.		
Ardmore, Anderton's lake		100
Ardmore Rod and Gun Club Lakes		750
Ardmore Water Works Lake		600
Ball Lake		600
Boyd Lake		300
Browns Creek		100
Brown's pond		200
Byrd's pond		500
Chickasaw Lake		300
Colley's bass lake		150
Lake Kinkade		300
Little's lake		600
Lykens Branch		100
Pretty Branch		100
Rice's lake		300
Roberts Pond		300
Rock Creek Lake		150
Rock Lake		100
Rodgers Pond		500
Silver Lake		150
Wilson Lake		500
Young's lake		300
Atoka, Gamble Creek		100
Hiwana Club Lake		300
Binger, Cedar Lake		70
Blair, Heath's pond		75
Canute, Elders Pond		55
Turkey Pond		55
Cordell, Brownlee's pond		150
Dill, Alpha Pond		150
Burnhardt's pond		75
Harrell Pond		75
Eldorado, Mauldin Lake		75
Sandy Creek		150
Elk City, Elk City Reservoir		110
Indian Pond		55
Enid, Elmwood Grove Lake		70
Erick, Terrells Lake		110
Foss, Phillips Pond		75
Frederick, Silver Lake		150
Williams Pond		150
Garvin, Crystal Lake		100
Gibbon, Spring Creek		35
Gotebo, Cavalry Creek		110
Minton's pond		110
Hinton, Walker Lakes		140
Hobert, Big Elk Creek		165
Little Elk Creek		275
Holdenville, City Reservoir		200
Hugo, Kulli Chito Lake		150
Lawrence, Lawrence Lake		200
Lehigh, Choctaw Lake		200
City Lake		100
Lookeba, Walnut Grove Lake		70
McAlester, Chapman Lake		100
Gordon Lake		100
Hardy's pond		375
Highland Lake		175
Whitehead's lake		100
Mangum, Cowan's pond		75
Hamerville Pond		75
Martins Ponds		150
Marietta, Askew Lake		300
Lake Edith		100
Marietta Rod and Gun Club Lake		300
Williams Creek		200
Mill Creek, Brushy Creek		300
Mill Creek		300
Three Mile Creek		200
Milburn, Blue River		300
Mountain View, Medicine Creek		70
Saddle Mountain Creek		105
Mountain View, Stinking Creek		70
Vankirk Lake		70
Norman, Ambrister's pond		150
O'Keene, Littrell's pond		35
Oklahoma City, Northeast Creek		200
Spains Crystal Springs Lake		225
Peoria, Lost Creek		250
Pittsburg, Lake Austin		100
Pittsburg Reservoir		400
Sayre, Salome Lake		110
Spiro, City Lake		300
Sulphur, Lawrence Lake		200
McAdams Lake		200
Willow Lake		100
Tishomingo, City Pond		150
Foley's pond		200
Peter Sandy Creek		200
Washita River		300
Wolf Spring Creek		150
Valliant, Glover Creek, West Fork		600
Pennsylvania:		
Brookdale, Quaker Lake		225
Silver Lake		225
South Dakota:		
Calone, Dog Ear Lake		500
Winner, Cottonwood Creek		250
Tennessee:		
Bristol. Holston River		400
Holston River, South Fork		400
Mountain City, Boiling Lake		100
Ripley, Hatchie River		200
Texas:		
Abilene, Deadman Creek		275
Alba, Craven's pond		75
Hopkins Pond		400
Lake McKnight		800
Silver Lake		400
Wright Mill Pond		400
Alto, Meadow Lake		125
Alta Loma, Silver Lake		150
Archer City, Ikard's pond		150
Arlington, Rudd's pond		250
Silver Lake		250
Asherton, Sullivan's pond		175
Athens, Button Willow Pond		125
Kooncreek Klub Lake		2,150
Atlanta, Richey's pond		500
Axtell, Thompson's pond		750
Bagwell, Riley Pond		500
Spring Pond		1,250
Baird, Clear Creek		400
Harris Pond		100
Bangs, Cross Pond		150
Shore's pond		50
Thornhill Lake		150
Bastrop, Goodman's lake		200
Martin's lake		300
Bedias, Box Pond		125
Bellville, Mill Creek		500
Benoit, Mustang Creek		633
Bettie, Anderson Pond		125
Dean Lake		500
Lillies Lake		500
Pankhurst Ponds		709
Big Sandy, Faulk's pond		500
Birome, Crawford's pond		75

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Texas—Continued.		
Bishop, Bishop Lake		450
Boerne, Ranger Lake		50
Brady, Anderson's pond		250
Brady Creek		750
Flat Branch Lake		250
Hudson Creek		500
Bronson, Huffman's pond		125
Brownwood, Brownwood Lake		500
Ford's pond		150
McClelland's pond		250
Smith Lake		150
Bryan, Fin and Feather Club Lake		150
Golf Lake		500
Buda, Hargis Pond		250
Calvert, Calvert Country Club Lake		400
Cameron, Fontaine & McLerran Pond		200
Campbell, Mitchell's pond		200
Canadian, Horse Creek Lake		857
Caro, Clear Branch Lake		600
Carthage, Walls Pond		125
Center, Brawley Pond		125
Clarksville, Cuthand Club Lake		500
Foreman's pond		500
Lake Charles		100
White Oak Lake		500
Clifton, Phillips Pond		150
Westley's pond		125
Cline, Turkey Creek		1,375
Clinton, Judy's pond		300
Coleman, Hords Creek		633
Wilkinson's lake		150
Collinsville, Hudspeth Pond		125
Columbus, Smith Pond		150
Comfort, Guadalupe River		400
Cooper, Bass Lake		700
Corbet, Willow Lake		375
Corsicana, Burks Lake		500
Lake Lynn		150
Lakes Nos. 1, 2, and 3		450
West Hardy Lake		500
Cotulla, Joe Jean Lake		100
Coupland, Goetz Lake		500
Crystal City, Jones Pond		300
Palm Pond		250
Section 86 Reservoir		175
Dallas, Kidd Spring Branch		125
Dawson, Dawson Club Lake		80
Eldorado Ranch Pond		750
Del Rio, Ireland Lake		1,375
Denison, Lake Burchfield		125
Rod and Gun Club Lake		500
Sand Creek Reservoir		1,925
Detroit, Bennefield's pond		500
Detroit Oil Mill Pond		40
Kerbow's ponds		1,000
Mathis Pond		500
Mathis & Cherry's pond		500
Dilley, Henry's pond		250
Dorchester, Higgins Pond		167
Doucette, Wigley Spring Pond		300
Dunlay, Saathoff's pond		100
Eagle Ford, Cowham Lake		300
Eastland, Davenport's pond		100
Lake Gonzolas		100
Eastland, Lake Horney		550
Lake View		275
Lyerla Pond		100
Electra, Chino Creek Pond		250
Willow Pond		250
Windmill Pond		250
Elgin, Sandahl & Bergman Pond		125
Fate, High Point Lake		800
Zollner's pond		115
Flint, Flag Lake		500
Gedder Pond		200
Grand Lake		500
Pecan Lake		200
Floresville, Ewing's pond		75
Floyd, Finnie Lake		400
Gassaways Park Lake		1,000
Fort Worth, Duringer Lake		1,645
Ellis Lake		960
Fosdick's pond		300
Lake View		685
Foukes Spur, Highland Pond		125
Little Sandy Creek		1,000
Moores Lake		125
Franklin, Fulton's pond		50
Lake Lela		50
Little Brazos River, East Fork		50
Gainesville, Artesia Lake		300
Blocker Creek		866
Brushy Elm Creek		766
Chin-Goons Lake		300
Elm Creek		500
Fish Creek		866
Hickory Creek		866
Leeper Creek		766
Pecan Creek		872
Rock Creek		766
Scott Creek		766
Spring Creek		866
Garrison, Little Joe Lake		300
Gaston, Round Lake		125
Germania, Osborne's pond		275
Gilmer, Abneys Lake		250
Porter's pond		500
Glidden, Lorine Pit Pond		1,500
Gladewater, Tuttle's pond		250
Gonzales, Thorn's pond		150
Gordon, McCallister's pond		100
Russells Lake		275
Goree, Coffman Lake		50
Gorman, Bass Lake		150
Granbury, Blue Branch		150
Grand Saline Saline Creek		2,000
Greenbrier, Beckham's pond		750
Duck Creek		750
Greenbrier Creek		750
Greenbrier Lake		750
Indian Creek		750
Mud Creek		750
Sand Pond		750
Williams Creek		750
Gresham, Pine Lake		200
Guadalupe River Station, Guadalupe River		425
Hallsburg, Bordvsky Lake		125
Rock Lake		125
Hamilton, Cow House Creek		500
Hamlin, McNeal's Lake		325
Heidenheimer, Wilder's pond		20
Hempstead, Hancock Lake		800
Thatchers Pond		250
Henrietta, Choates Pond		720
Hillsboro, Patterson Lake		685

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.	Disposition.	Fry.	Fingerlings, yearlings, and adults.
Texas—Continued.			Texas—Continued.		
Honey Grove, Fin and Feather Club Lake		200	Marshall, Silver Lake		1,000
Hohenberger's pond		125	Mart, Sunny Lake		250
Hubbard, Blount Pond		500	Mathis, Willow Pond		275
Jones Pond		1,000	Meridian, Meadowside Pond		125
Lofgren's pond		40	Mico, Medina Valley Pond		4,800
Mayfield Pond		500	Mineola, Butler Lake		500
T. & B. V. Pond		30	Emory Pond		1,000
Willett Pasture Pond		500	Hannah Lake		500
Yonkapin Pond		30	Hollands Pond		150
Huntington, Lake Bessie		300	Rock Falls Club Lake		500
Iatan, Kock's pond		100	Mineral Wells, Caddo Creek		1,200
Imogene, Ray's pond		150	Elmhurst Park Lake		850
Italy, Campbell Lake		40	Oak Hill Lake		425
Meharg Lake		40	Mount Selman, Phialphia Lake		125
Jacksboro, Lost Creek		500	Wade Lake		500
Twin Mountain Lake		333	Murchison, Cumbie's pond		500
Jacksonville, Davis Lake		500	Nacogdoches, Blounts Pond		600
Park Lake		500	Naconichi Creek		600
Kaufman, Bishop Lake		500	White House Lake		600
Snow Lake		500	Naples, Jennings Lake		500
Kemp, Berry Pond		1,998	Navasota, Lotts Pond		200
Cedar Lake		666	New Boston, New Boston Fishing Club Lake		500
Cedar Pond		666	New Braunfels, Comal River		3,000
Clear Lake		666	Guadalupe River		4,850
Club Lake		666	Spring Branch		3,150
Garner Lake		666	Newsome, Bailey Lake		125
Henderson Lake		666	Davis Pond		62
Jarvis Pond		666	Elwood Club Lake		400
Kemp Hill Lake		666	Gillam's pond		125
Long Lake		666	Goose Lake		125
Reasnover's pond		666	Harris Lake		125
Sycamore Lake		666	Harris Pond		125
Kerrville, Clark Pond		375	Hicks Lake		125
Guadalupe River		2,500	Hickory Pond		125
Gus Lake		100	Martin's pond		63
Harris Pond		125	Morris Lake		250
Kott Lake		65	Newsome Lake		125
Lake Cawthorne		200	Overstreet Pond		125
Moore Pond		170	Pine Lake		125
Pebble Pond		150	Taylor's pond		200
Sauer Lake		75	White Lake		125
Town Creek		250	Willow Lake		125
Wachter Pond		200	Newton, Hall's pond		300
Kress, Adkins Pond		250	Park's pond		300
Lamesa, T. J. F. Lake		857	New Ulm, Gerbermann's pond		500
Lampasas, Culver's pond		300	Orange, Sabine River		1,650
Lancaster, Moreland Lake		250	Orth, Rogers Pond		300
Laredo, La Pita Lake		190	Paige, Bauerkemper's pond		125
Lelia Lake, Lelia Lake		857	Rohde's ponds		375
Leon Springs, Leon Creek		2,500	South End Pond		125
Lexington, Pursers Lake		525	Palestine, Pessoney's lake		60
Lincoln, Mucke Pond		150	Paris, City Lake		200
Lockney, Sunnyside Lake		857	Gordon Lake		200
Lometa, Procter's pond		250	Gordon Country Club Lake		1,250
Longview, Barker's pond		1,000	Pettigrew Lake		500
Lake Toler		500	Prairie View Lake		500
Sabine Club Lake		1,000	Rodgers Lake		500
Teague's pond		500	Paint Rock, Cook's pond		633
Longworth, Longworth Lake		350	Fuzzy Creek		633
Lone Oak, May's pond		90	Hog Creek		633
Lyons, Rubach's pond		250	Pearsall, McKinnon & Davies Lake		250
Mabank, Grays Pond		500	Perry, Bluhm's pond		250
Mitchell's pond		500	Stamp-Hill Lake		250
Rice's pond		500	Phelon, Calvin Pond		400
Madisonville, Goode's pond		125	Pineland, Pineland Pond		250
Manchaca, Cameron Lake		200			
Onion Creek		500			
Summerrow Lake		600			
Manor, Cottonwood Pond		250			
Marfa, Lake Colpitts		1,000			
Marlin, Scheef's lake		250			

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Texas—Continued.		
Pittsburg, Ferndale Club Lake		100
Flag Pond		800
Plano, Kendrick's pond		500
Spring Creek		500
Plainview, Hay's pond		250
Point, Kerr's pond		75
Post, Two Draw Pond		857
Poteet, Ernst's pond		20
Maverick's pond		265
Pritchett, Mosers Pond		500
Quanah, Shortie Creek Pond		857
Queen City, Hunts Pond		500
Hutchinson Pond		500
Renner, Spanky Lake		200
Riesel, Dietrick Pond		250
Riesel Pond		250
Rochelle, Neal's pond		250
Rockdale, Felton Lake		200
Rockwall, Railroad Pond		125
Tucker Lake		125
Rogers, Baugh Meadow Pond		25
Bullock's pond		20
Rosebud, City Lake		525
Stillwell's lake		150
Rotan, Red Oak Lake		150
Willow Lake		150
Rusk, Beans Creek		50
State Lake		40
Sabinal, Frio River		1,375
Santa Anna, Garretts Lake		150
San Angelo, Bridgeview Lake		160
Concho River		100
San Antonio, Blue Wing Lake		25
Dulling Lake		400
West Lake		275
San Augustine, Fountain's pond		125
San Benito, San Benito Pond		450
Sheridan, Baxter's pond		125
Sherman, Club Lake		500
Country Club Lake		550
Heflin's pond		40
Kote's pond		500
William's pond		125
Smithville, Eagleston's pond		2,000
Shipps Lake		500
Snyder, Horse Pond		250
Sprinkle, Big Walnut Creek		4,000
Spur, Bull Creek Lake		150
Wilson Lake		350
Sulphur Springs, Brinker Lake		200
Hendersons Pond		60
Hurley's pond		200
Sutherland Springs, Cibolo River		1,000
Sweetwater, Santa Fe Lake		550
Taylor, Flag Springs Pond		200
Washington Lake		30
Teague, Williford's pond		100
Temple, Montgomery's pond		685
Terrell, Beavers Pond		125
Dennehy's pond		125
Durham Pond		125
Eason Pond		125
Goose Lake		1,000
Hellams Pond		2,000
Lovell's lake		500
Rose Hill Lake		225
Sheet Pond		125
Thorndale, Newton's pond		125
Thornton, Moody's pond		150
Timpson, Ramsey's pond		300
Texas—Continued.		
Truscott, Truscott Pond		150
Tye, Daugherty's pond		275
Tyler, Beaver Dam Lake		625
Brumby Lake		625
Chinquapin Lake		625
Galy Lake		625
Griffin Lake		625
Hamilton Mill Pond		625
Harris Creek		625
Haskins Pond		200
Hill Lake		1,250
Hitts Mill Pond		625
Horseshoe Lake		625
Joly Lake		625
Lake Park Association Lake		625
Pine Lake		625
Saline Creek		625
Twin Lakes		625
Uvalde, Cartwright's pond		375
Kincaid's pond		250
Nueces River		1,375
Van Alstyne, Dumas' pond		150
Vernon, Spring Lake		858
Von Ormy, Medina River		1,025
Waco, Cooper's lake		685
Crows Pond		400
Forest Lake		125
Shelton Pond		685
Spring Lake		125
Watts Pond		960
Westbrooks Lake		685
Waelder, Gentry Pond		300
Waring, Guadalupe River		375
Waxahachie, Bell Branch Lake		250
Weatherford, Red Oak Lake		275
Weimar, Voitle's pond		150
Wellington, Forbis Pond		100
Wells Point, Boshears Lake		1,000
Goodnight Park Lake		500
Russell's pond		250
Taylor's lake		500
Thorn Lake		500
Williams Lake		500
Wynne's lake		1,000
Whitney, Wieches Pond		200
Wichita Falls, Clear Lake		870
Denver Lake		870
Horseshoe Lake		870
Fort Worth & Denver Lake		150
Sherrod Lake		870
Windom, Gin Pond		125
Winters, Bedfords Lake		100
Yoakum, Tates Pond		150
Utah:		
Lund, Gifford's pond		50
Ogden, Wilson Pond		75
Salt Lake City, Silver Lake		200
Virginia:		
Amelia Court House, Williams Pond		200
Ash Cake, Maple Grove Pond		250
Ashland, Bowles Pond		250
Kings Pond		250
Luckes Pond		250
Barbours Creek, Craigs Creek		400
Baskerville, Elam's lake		200
Swamp Lake		200
Twin Lake		200
Beaver Dam, Little River		500
Bess, Potts Creek		375
Bon Air, Bellona Pond		200

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Virginia—Continued.		
Chase City, Otter Creek Pond		210
Cleveland, Clinch River		400
Courtland, Nottoway River		500
Covington, Dunlap Creek		400
Craigsville, Big River		400
Culpeper, Mountain Run	1,000	
Danville, Cain Creek		300
Chandlers Creek		300
Dan River		2,000
Dan River Lake		300
Sandy River		1,000
Wolf Island Creek		1,000
Woods Pond		500
Doswell, Harman's pond		200
Dry Fork, Jones Pond		200
Dundas, Callis Mill Pond		250
Elba, Moore's pond		150
Westham Fishing and Country Club Pond		75
Ellerson, Brandy Pond		250
Water's pond		250
Emporia, Meherrin River		600
Eulalie, Ca Ira Mills Pond		500
Franklin Junction, Fitzgerald's mill pond		200
Front Royal, Shenandoah River		1,000
Gladys, Seneca Creek		750
Pigeon Run Pond		200
Jordan, Potts Creek		375
Lanexa, McKenney's pond		200
Laurel, Bolton Pond		250
Leesburg, Goose Creek	1,000	
Oak Grove Lake	1,000	
Lee Hall, Lee's pond		200
Lester Manor, Walker & Colemans Mill Pond		200
Louisa, Gold Mine Creek		250
Martinsville, Smiths River		400
Milford, Broaddus Pond		300
New Castle, Caldwells Pond		200
Norfolk, Chub Lake		1,200
Ontario, Eubank Pond		235
Pemberton, Moon's pond		150
Trice's mill pond		150
Petersburg, Chesterfield Pond		500
Old Tom Creek		500
Providence Forge, Providence Forge Pond		600
Ropers Creek		600
Purdy, Batte's pond		250
Quinton, Waterview Mill Pond		230
Randolph, Figg's pond		100
Richmond, Allen's pond		250
Falling Creek Pond		500
Fonticello Pond		375
Glazebrook & Thomas Pond		375
Grimmell's pond		250
Licking Creek Pond		750
Powell's pond		375
Springfield Pond		250
Robions, Pinifer Park Pond		230
Rock Castle, DeNoon's pond		150
Soudan, Grass Creek		225
Stony Creek, Pyus Pond		200
Tunstalls, Hempstead Pond		200
Victoria, Meherrin River		750
Walkers, Walkers Pond		200
Waverly, Lake Shingleton		250
Newell's mill pond		250
Virginia—Continued.		
Whaleyville, Freeman Mill Pond		250
Widewater, Aquia Creek Pond		250
Yale, Moores Mill Pond		500
Crawford's pond		500
Zuni, Neblet's mill pond		600
West Virginia:		
Buckhannon, Buckhannon River		600
Charlestown, Shenandoah River		600
Harpers Ferry, Potomac River		800
Shenandoah River		600
Hendricks, Dry Fork River		800
Holly Junction, Elk River		800
Martinsburg, Opequon Creek		600
Millville, Shenandoah River		600
Moorefield, Potomac River, South Fork of South Branch		750
Philippi, Tygarts Valley River		600
Shepherdstown, Potomac River		6,675
Weston, West Fork River		600
Webster Springs, Elk River, Back Fork		500
Wisconsin:		
Almena, Upper Turtle Lake		500
Altoona, Lake Altoona		300
Aniwa, Pike Lake		120
Sand Lake		120
Bangor, La Crosse River		200
Parks Lake		200
Wiles Lake		200
Wolfs Pond		200
Barneveld, Adamsville Creek		150
Barronette, Mill Pond		125
Birchwood, Sturges Lake		200
Birnamwood, Food Lake		120
Mayflower Lake		120
Brodhead, Sugar River		375
Burlington, Browns Lake		375
Cable, Little Lake		125
Long Lake		125
Number Four Lake		125
Perry Lake		125
Price Lake		125
Wiley Lake		125
Centuria, Balsam Lake		250
Deer Lake		125
Half Moon Lake		250
Long Lake		125
Loveless Lake		125
Poplar Lake		150
Chetek, Chetek Lake		400
Kegama Lake		400
Prairie Lake		300
Chippewa Falls, Bob Howie Lake		175
Chippewa River		500
Cornell Lake		175
Ermatinger Lake		525
Jim Falls Pond		175
Lake Hallia		175
Long Lake		175
Miller's mill pond		175
Mud Lake		175
Popple Lake		175
Yellow River		700
Colfax, Big Eddy Pond		125
Larsen's pond		150

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.		
Colfax, Tollefsons Bay		175
Crandon, Bass Lake		75
Bishop Lake		75
Booze Lake		75
Clear Lake		75
Crane Lake		75
Devils Lake		75
Dry Lake		75
Duck Lake		75
Hemlock Lake		75
Lake Whitby		75
Little Rice Lake		75
Little Sand Lake		75
Long Lake		100
Mole Lake		100
Oak Lake		100
Pickerel Lake		100
Rat Lake		100
Riley Lake		100
Roberts Lake		100
Stewart's lake		100
Surprise Lake		100
Cumberland, Beaver Dam Lake		175
Granite Lake		125
Kerbec Lake		125
Pipe Lake		125
Sand Lake		125
Vermillion Lake		125
Devils Lake, Devils Lake		400
Durand, Bear Lake		400
Eagle Point, Oneil Creek		250
East Superior, Amnicon Lake		100
Lyman Lake		100
Mary's lake		200
Elcho, Otter Lake		166
Hackley, Big Bass Lake		375
Big Twin Lake		375
Lake Helen		375
Hartland, Lake Keesus		400
Haugen, Bear Lake		125
Devils Lake		125
Mitchell Lake		125
Tuesday Lake		125
Hayward, Big Moose River		100
Big Spider Lake		125
Clear Lake		125
Herrington Lake		125
Lake Court Oreilles		200
Little Moose River		100
Little Spider Lake		125
Mud Lake		125
North Lake		125
Hillsboro, Baraboo River Pond		200
Hillsboro Mill Pond		200
Holcombe, Round Lake		250
Honey Creek, Tichigan Lake		375
Iron River, Big Pike Lake		150
Camp 20 Lake		150
Crystal Lake		100
East Eight Mile Lake		150
Fire Lake		150
Iron Lake		150
Pike Lakes		450
Trappers Lake		150
Kansasville, Eagle Lake		375
Ladysmith, Chippewa River		175
Flambeau River		175
Lake Shamrock		500
Lake Stephenson		175
Potato Lake		175
Wisconsin—Continued.		
Lake Geneva, Lake Como		375
Lake Nebagamon, Kinlock Lake		150
Lake Minnesung		100
Lake Nebagamon		100
Loon Lake		150
Lynden Lake		100
Mastin Lake		150
Minnow Lake		150
Niggar Lake		150
Steele Lake		100
Twin Lakes		100
Lampson, Lily Lake		200
Marshfield, Little Eaupleine River		150
Yellow River		150
Medford, Coon Lake		175
Hulls Lake		175
Kluches Lake		175
Lake Esadore		175
Lake Nineteen		100
Lake Salem		100
Lake Thirty		100
Pickerel Lake		100
Richter Lake		175
Sacketts Lake		175
Twin Lakes		175
Mellen, Beaver Lake		125
Bladder Lake		125
Caroline Lake		150
English Lake		125
Lake Herbert		125
Long Lake		125
Meader Lake		125
Mineral Lake		125
Twin Lakes		125
Menominee, Cedar Lake		175
Chippewa River		175
Clear Lake		175
Cut Off Lake		200
Lake Menoni		175
Red Cedar River		175
Stump Slough Lake		175
Tibbitts Lake		175
Wilson Pond		175
Young Lake		200
Mercer, Trude Lake		350
Milwaukee, Wind Lake		500
Mondovi, Mirror Lake		300
Nashotah, Moose Lake		525
Nashville, Crystal Lake		100
Dry Lake		150
Jungle Lake		100
Lily Lake		100
Loon Lake		100
St. Johns Lake		100
Strawberry Lake		100
Norwalk, Kickapoo River		200
Moores Creek		100
Norrie, Lake Gotoit		100
Salem, Hooker Lake		625
Sauk City, Koenig's mill pond		300
Shell Lake, Shell Lake		375
Silver Lake, Silver Lake		375
Solon Springs, Black Fox Lake		125

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LARGE-MOUTH BLACK BASS—Continued.

Disposition.	Fry.	Fingerlings, yearlings, and adults.
Wisconsin—Continued.		
Solon Springs, Long Lake		125
Twin Lakes		125
Young Lake		100
Sparta, City Pond		100
Perch Lake		200
Walworth Pond		200
Spring Green, Wisconsin River		300
Stanley, Brown's lake		500
Yellow River		500
Stone Lake, Adell Lake		125
Lake Donald		150
Lake Lois		150
Nickle Lake		125
Slim Lake		125
Spring Lake		125
Three Lakes, Big Lake		200
Big Fox Lake		200
Big Stone Lake		200
Clear Water Lake		200
Columbus Lake		200
Four-Mile Lake		200
Little Fork Lake		200
Macosin Lake		200
Maple Lake		200
MedicineLake		200
One Stone Lake		200
Planting Ground Lake		300
Range Line Lake		300
Spirit Lake		200
Thunder Lake		200
Town Line Lake		200
Virgin Lake		200
Trevor, Rock Lake		375
Turtle Lake, Skinaway Lake		375
Twin Lakes, LakeElizabeth		625
Lake Mary		625
Wausau, Bauch Pond		100
Big Moon Lake		100
Big Rib River		100
Big Sandy Creek		100
Black Creek		100
Wisconsin—Continued.		
Wausau, Brokaw Pond		75
Buntruck Slough Pond		100
Canada Creek		100
Coles Pond		100
Curtiss Creek		100
Deadman Pond		100
Eau Claire Pond		100
Eau Claire River		100
Four-Mile Creek		100
Half Moon Lake		100
Jimore River		100
Katz Pond		100
Lake Moon		100
Lake Wausau		100
Little Moon Lake		100
Little Rib River		100
Middle Sandy Creek		75
Parchers Pond		100
Rib Lake		100
Rothchilds Lake		100
Schwister Lake		100
Short Portage Lake		100
Silver Creek		100
Sturgeon Pond		75
Wisconsin River		100
White Lake, White Lake		200
Winneboujou, Elizabeth Lake		100
Island Lake		100
Lake Helgerson		100
Pocket Lake		300
Rush Lake		100
Sand Bar Lake		100
Wonewoc, Baraboo River		300
Baraboo River, East Branch		200
Baraboo River, North Branch		200
Baraboo River, West Branch		200
Horseshoe Pond		100
Mill Pond		200
Woodruff, Clear Lake		575
Sweden:		
Kloten		200
Total[a]	18,100	485,993

SUNFISH (BREAM).

Disposition.	Fingerlings, yearlings, and adults.
Alabama:	
Abbeville, Hicks Pond	200
Capps Pond	200
Bankston, Gardner's pond	200
White's pond	400
Birmingham, Warren's pond	50
Camden, Bay Pond	150
Chase, Cullom's lake	200
Clayton, Floyd's pond	50
Martin's ponds	100
Coker, Robertson Lake	150
Collinsville, Lake Lay	100
Cullman, Graham's pond	150
Alabama—Continued.	
Cullman, Scheffel's pond	200
Demopolis, Elmore's pond	150
Eleanor, Simms Pond	150
Elkmont, Locust Pond	400
Eoline, Frog Lake	150
Murphy's pond	150
Eufaula, Hill's pond	100
Pruden's pond	100
Fayette, Berry's pond	200
Fort Payne, Steeles Lake	100
Goodwater, Joyner's pond	50
Goshen, Sikes Mill Pond	100

[a] Lost in transit, 885 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

SUNFISH (BREAM)—Continued.

Disposition.	Fingerlings, yearlings, and adults.
Alabama—Continued.	
Greensboro, Lavender's pond	450
Stickney's pond	300
Guin, Pearce's ponds	400
Hartford, Phelps' pond	100
Hartselle, Aldridge's pond	150
Jemison, Franklin ponds	50
Millport, Gentry's mill pond	400
Mobile, Black Fork Creek	300
Opelika, Lake Opelika	50
Odam Creek	100
Peachburg, Weem's pond	100
Phoenix, Harden Lake	100
Poplar Spring Pond	100
Randolph, Spring Lake	25
Russellville, Burgess Lake	200
Douglas Pond	150
Hale's pond	200
Sanford, Knox's pond	100
Scottsboro, Coulson's pond	100
Sellers, Garrett's pond	100
Giddens' pond	100
Mount Carmel Fish Pond	100
Sylacauga, Tallasahatchee Creek	200
Tallassee, Carmacks Pond	100
Thorsby, Rollins Pond	25
Troy, Black's pond	50
Whaley's pond	50
Youngblood Pond	200
Winfield, Bowen's ponds	350
White's pond	150
Woodstock, Reno Lake	150
Arkansas:	
El Dorado, Rock Island Lake	80
Snow Lake	80
Sorrell's pond	80
Helena, Mississippi River	15,650
Huttig, Pryor's pond	40
Mammoth Spring, Warm Fork	6,230
Wynne, Killone Pond	50
Colorado:	
Pueblo, Chew's pond	1,150
Connecticut:	
New Haven, Hubbard's ice pond	150
Florida:	
Tampa, Cow Horn Lake	25
Winter Park, Lake Mizel	25
Lake Osceola	25
Georgia:	
Allie, Fuller Branch	100
Americus, Seals Mill Pond	125
Ashburn, Massey's pond	125
Atlanta, Clara Meer Lake	500
Crook's pond	250
East Lake	200
Felker's pond	225
Grant Park Lake	500
Lakewood Lake	470
Lake Ormewood	550
Lavery's pond	550
Lorraine's pond	100
Piedmont Park Lake	500
Ponce de Leon Park Lake	500
Schoen's pond	500
White City Park Lake	500
Athens, Lake Chulnota	100
Middle Oconee River	100
Oconee River	850
Augusta, Augusta Game Preserve Pond	200
Hankerson pond	100
Pund's pond	700
Timmons Pond	200
Bartow, Williamson Creek	275
Baxley, Brown's pond	100
Bishop, Dickens' pond	150
Georgia—Continued.	
Blackshear, Walkers Mill Pond	100
Bremen, Beech Creek Pond	75
Copeland's pond	150
McBurnett's pond	300
Boneville, Johnson's pond	125
Bowdon Junction, Bowdon Ry. Pond	300
Box Springs, Kings Creek	200
Buena Vista, Taylor's pond	75
Calhoun, Hayes Pond	150
Roach's pond	100
Canton, Etowah River	100
Cave Spring, Talalah Lake	150
Chamblee, Manley's pond	200
Clarkston, Cornbrock Pond	150
Jolly's pond	75
Sam's pond	150
Conyers, Hicks' pond	150
Covena, Mill Creek	100
Phillips' pond	150
Covington, Lunsford's pond	150
Crawfordville, Ogeechee River	100
Cunningham, Hunt Pond	100
Vans Valley Pond	100
Cusseta, King's pond	100
Cuthbert, Bealls Pond	100
Carters Pond	100
Dixons Pond	100
Crystal Lake	100
Geffs Pond	100
Lake View	100
Weatherbys Pond	100
Daisy, De Loach Pond	275
Dalton, Clearwood Lake	100
Crystal Lake	100
Elm Pond	100
Decatur, Morgan's pond	150
Poplar Spring Lake	75
Douglasville, McElreath's pond	100
Drybranch, Tharpe's lake	250
Duluth, Pace's pond	250
Edison, Maury's pond	250
Elberton, Beaverdam Creek	100
Ellanville, Rainey's mill pond	75
Eldorado, Segraves' pond	100
Eufaula, Rutland's pond	200
Fairburn, Roberts Pond	100
Farrar, Wyatts Pond	125
Fitzgerald, Paulk Pond	250
Gainesville, Davis' pond	50
Moore's pond	100
Nimberville Creek	100
Georgetown, Ogletree's pond	200
Gray, Bermuda Park Pond	150
Greenville, Terrell Pond	200
Hamilton, Harris' pond	100
Harlem, Campania Pond	100
Cow Creek	100
Phillips's pond	100
Harrisburg, Litton's pond	100
Hartwell, McMullan Pond	400
Hawkinsville, Ryan's pond	125
Hephzibah, Briggs's pond	100
Hiram, Stancel's pond	100
Hogansville, Haynie's pond	100
Jackson, McCord's mill pond	150
Reed Creek	150
Tussecha Pond	150
Junction City, Miller's pond	150
Lenox, Sutton's pond	125
Lithonia, Honey Creek	600
McDonough, Brown's pond	125
Macon, Smith Pond	100
Vickers' pond	125
Manor, Henderson's pond	100
Marietta, Maloney Spring Lake	100

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

SUNFISH (BREAM)—Continued.

Disposition.	Fingerlings, yearlings, and adults.
Georgia—Continued.	
Meigs, Long Branch Pond	100
Spring Head Pond	100
Menlo, Stephenson's pond	150
Metter, Grayham Pond	150
Midland, Mount Hope Pond	100
Monticello, Kelly's pond	100
Moreland, Cureton's pond	100
Moultrie, Clytiemae Pond	100
Naylor, Carter's pond	200
Tucker Pond	100
Newman, Bohannon Pond	50
Wynns Pond	200
Norristown, Mule Pen Creek	35
Norwood, Dennis' pond	100
Duckworth's pond	100
Howell's pond	100
Swains Pond	100
Nunez, Youman's pond	135
Ochlochnee, Black Water Run	100
Palmetto, Harris Pond	100
Hearn's pond	100
Walthall Pond	100
Perry, Aultman's pond	100
Reynolds, Mosely & Neisler Pond	100
Rochelle, Edwards Pond	125
Scotland, Gum Swamp Creek	150
Seville, Tippett's pond	125
Stockbridge, Ward's pond	125
Stone Mountain, Tweedell's pond	400
Hicks' pond	250
Talking Rock, Keeter's pond	150
Tate, Weaver Mill Pond	100
Tarrytown, Calhoun's pond	250
The Rock, Stafford's pond	100
Thomasville, East Lake	100
Roosevelt Pond	100
Smith's pond	100
Taylor's pond	100
Ward's pond	100
Watson's pond	250
Williams Mill Pond	100
Toccoa, Scott's pond	100
Tucker, Simpkins' pond	200
Upatoi, McKee Pond	100
Warrenton, Aldred Pond	100
Lowe's pond	100
Whigham, Whigham's pond	100
Williamson, Katrina Pond	100
Youngs, Peek's pond	150
Zebulon, Wilson's pond	100
Illinois:	
Belleville, Lake Christine	1,250
Carbondale, Bryan's lake	500
Cedar Lake	500
Woods Lake	500
Carlinville, Oakview Pond	250
Carterville, Tremont Pond	250
Chambersburg, Ham's pond	150
Hillsboro, Major's pond	250
Hunt City, Bowman's pond	200
Irving, Lyerla Pond	500
Meredosia, Meredosia Bay	3,800
Millersville, Bickerdikes Pond	250
Millstadt, Bluff Side Lake	1,000
New Burnside, Boyer Pond	200
Calder's pond	200
Caspers Old Pond	100
Shipman, Olmsted Pond	250
Indiana:	
Columbia City, Peabody's pond	100
Fairmount, Kemmer's pond	100
Kentland, Orchard Lake	150
La Porte, Tamarack Lake	300
Lebanon, Spencers Pond	100
Madison, Kentucky Creek	300
Indiana—Continued.	
Manchester, Bielby Pond	100
Osgood, Shadeland Pond	100
Richmond, Thistlewaite Lake	100
Union City, Young's pond	200
Winchester, Johnston Gravel Pond	100
Iowa:	
Bellevue, Mississippi River	40,450
Coin, Christensen's pond	100
Lansing, Mississippi River	3,500
Kansas:	
Cominskey, Troutman's pond	125
Kansas City, Fairdale Lake	200
Kirwin, Case's pond	200
Marrow, Huyck's pond	125
Kentucky:	
Allensville, Gill's pond	300
Cadiz, Little River	800
Danville, Dix River Lake	500
Frankfort, Sullivan's pond	300
Franklin, Tisdales Pond	150
Wilson's pond	250
Georgetown, Lake Moreland	200
Graysons Springs, New's pond	150
Hopkinsville, Howell Pond	300
Little River, West Fork	600
Jackson, Kentucky River	1,000
Louisville, Avery Reservoir	150
Lake Lansdowne	750
Marion, Baker's pond	100
Maysville, Mitchell's pond	300
Rowletts, McKinney's lake	150
Russellville, Becker Pond	150
Caldwell Pond	150
Edwards Pond	150
Stumping Ground, Southworth Pond	300
Tip Top, Cedar Grove Pond	200
Hart's pond	150
Ortholer Pond	100
Wood Pond	100
Louisiana:	
Amite City, Elmsley Pond	150
Clinton, Jack Pond	200
Corbin, Bradford's pond	150
Ponchatoula, Settoon's pond	150
Tremont, Butler's pond	100
Perrine's pond	100
Wisner, Hicks Pond	40
Maryland:	
Severn, Severn Ponds	520
Massachusetts:	
Bridgewater, Gammon's pond	150
Mississippi:	
Ackerman, Yockanookany Club Lake	150
Amory, Dalrymple Lake	150
Baldwyn, McCollum's pond	150
Nelson Spring Pond	150
Bay St. Louis, Shields' pond	300
Blue Mountain, Medlins Pond	200
Brandon, May's pond	300
Brooksville, May Pond	150
Centerville, Willow Lake	200
Clarksdale, Sunflower Pond	150
Columbus, Tombigbee River	300
Willis Lake	400
Como, Maddux Pond	150
Corinth, Lake Clarence	200
Lamberths Lake	200
Crawford, Irby Pond	250
Crystal Springs, Aby Lake	150
Epley, Hudson's pond	200
Flora, Hawkins Ponds	550
Purvis Pond	150
Gloster, Cassels Pond	100
Greenwood Springs, Broyles' pond	300
Hazlehurst, Ellis Lake	200

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

SUNFISH (BREAM)—Continued.

Disposition.	Fingerlings, yearlings, and adults.
Mississippi—Continued.	
Hazlehurst, Sexton's pond	150
Houston, Houston Park Lake	400
Jackson, Bailey Avenue Pond	150
Centennial Lake	150
Crowder's Lake	150
Horse Creek	150
Lynch's pond	150
Moody's pond	150
North Park Lake	150
Spring Lake	450
Sulphur Spring Lake	150
White Creek	150
Kosciusko, Peeler's pond	150
Landon, Albrecht Pond	150
Lauderdale, Willow Pond	150
Louisville, Mitchel's pond	200
Lyman, Log Pond	150
McCool, Fancher's pond	400
Macon, Coleman's pond	150
Cypress Lake	150
Eilano Ponds	300
Howards Lake	150
Sparkman's pond	150
Magee, Duck Pond	150
Magnolia, Allen Bros.' pond	100
Minnehaha Creek	150
Mantee, Mantee Lake	200
Mayhew, May Farm Pond	150
Meridian, Oaklawn Pond	450
Schonrock Pond	200
Walker's pond	300
Monticello, Maxwell's pond	200
Muldon, Cunningham's pond	150
Natchez, Ranck's pond	200
New Albany, Bias Mill Pond	150
Holland's pond	150
McBrayer's pond	200
Parker's pond	150
Noxapater, Estes Pond	200
Penn, Cook's pond	150
Pheba, Gosa Pond	150
Philadelphia, Rea's pond	200
Quitman, Lake Ruth	150
Star, Holliday's pond	150
Starkville, Wade's pond	150
Strongs Station, Mealer Bros.' pond	150
Toomsuba, Hurtts Pond	150
Middle Pond	150
Page's pond	150
Saxon Pond	150
Tupelo, Hill's lake	250
Jackson's pond	300
Motley's pond	300
Phillips' pond	250
Rains's pond	300
Verona, Garmon's pond	100
West Point, Hamlin's pond	150
Hawkins's pond	150
Ivy Lake	150
Walker Gregory Lake	150
Wesson, Anderson's pond	150
Bush Pond	150
Decell's pond	150
McGrath Pond	150
Renfroe Pond	150
Williams's pond	150
Woodville, Lake Bonnie Mead	200
Missouri:	
Arlington, Piney View Cottage Pond	100
Villings, Walker's pond	100
Newburg, Knotwell Creek	100
Seymour, Ozark Plateau Pond	100
Walnut Grove, Toalson Pond	200
Nebraska:	
Verdon, Harden's Lake	100
Spring Lake	100
New Jersey:	
Passaic, Mills's pond	200
North Carolina:	
Concord, Cotton Mill Pond	100
Substation Pond	100
Durham, Lilley's pond	100
Fayetteville, Bonniebrook Pond	200
Franklinton, Norvell's pond	150
Star Farm Pond	150
Fremont, Cooks Pond	400
Peacock Pond	400
Garland, Smith's pond	500
Goldsboro, Country Club Lake	550
Tara Farm Pond	400
Graham, Country Club Lake	400
Holt's Mill Pond	400
Scott's pond	400
Jonesboro, Little River	1,000
Lenoir, Spencer's pond	100
Lexington, Berrier's pond	150
Louisburg, Ingleside Lake	500
Lowell, Gash's pond	150
Mill Brook, Lassiter Pond	400
Mocksville, Dutchman Creek Pond	250
Morven, Ratliff's pond	150
Mount Gilead, Little River	1,000
Newton, Setzer's pond	150
North Wilkesboro, Whittington's pond	150
Oxford, Grassy Creek	500
Pittsboro, Hailbourn Pond	300
Polkton, Lanes Creek	550
Raleigh, Norwood Pond	650
Williams's pond	300
Rutherfordton, Dickerson's pond	100
Salisbury, Kesler's pond	150
Statesville, Cedar Lake	300
Stoneville, Black Branch Pond	250
Tryon, Shields Pond	200
Walnut Cove, Pepper's Mill Pond	250
Ross Pond	100
Willow Spring, Rowland's pond	400
Ohio:	
Bradford, Greenville Creek	400
Columbus, Fisk's pond	100
Parma Lake	200
Rocky Fork Creek	350
Dayton, Kauffman Pond	100
Oklahoma:	
Ardmore, Courtney Lake	400
Kinkade's lake	400
Lake Komo	1,000
Rock Lake	400
Stuart's pond	400
Vale Lake	400
Blair, Howser Pond	250
Caddo, Turnbull's pond	400
Calera, Willow Lake	400
Comanche, Brown's pond	100
Custer, Smith Pond	250
Durant, East Lake	400
Hannon's Lake	400
Risner's Lake	400
Elgin, Diamond Pond	100
Lawton, St. Clair's pond	100
Leander, Hazlewood's pond	30
Ledbetter, Ace Pond	30
Stuermer's pond	30
Lehigh, Simmons Pond	250
Mangum, Cowan's pond	250
Manitou, Edwards Pond	250
O'Keene, Horseshoe Pond	250
Oklahoma City, Crystal Springs Lake	100
Perry, Silver's Pond	100
Spiro, Lowrie's pond	250
Stuart, Willow Pond	100
Pennsylvania:	
Reading, Peters Lake	500

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

SUNFISH (BREAM)—Continued.

Disposition.	Fingerlings, yearlings, and adults.
South Carolina:	
Aiken, Joyce Pond	700
Anderson, Brogoa Mill Lake	50
Osborn's pond	100
Snipes Pond	60
Angelus, Huntley's pond	250
Belmont, Boyd's pond	20
Craig's pond	20
Currence Ponds	40
Glenn's pond	20
Harper's pond	20
Belton, Broadmouth Creek, branch of	100
Bishopville, Beaver Dam Pond	100
Central, Rowland's pond	250
Chesterfield, Gaddy Pond	70
Rivers Pond	400
Columbia, Dent's pond	125
Kendall's pond	100
Maxwell Pond	600
Mill Pond	50
Sylvan Pond	50
Taylor's pond	125
Easley, Eades Pond	250
Garrick's pond	300
Griggs's pond	300
Labkey's pond	300
Nally's pond	250
Eastover, McKenzie Pond	100
Enoree, Chumley's pond	50
Poole's pond	50
Florence, Settles Pond	50
Fountain Inn, McCarter's pond	100
Greenville, Houston's pond	100
Honea Path, Greer's pond	100
White Hall Pond	600
Johnston, Hilliard Pond	125
Lamar, Andrews Mill Pond	100
Lanford, Beaver Dam Pond	50
Laurens, Long Branch	200
Liberty, Lang Pond	50
Wood Pond	50
Marion, LeGette's pond	600
Mount Holly, Medway Lake	600
Neeses, Corbett Pond	500
North, Jones Pond	600
Pageland, Funderbunk Pond	100
Jenkins's pond	100
Pomaria, Cannons Lake	150
Holloway Pond	150
Price Pond	100
Roebuck, Periwinkle Pond	50
Rock Hill, Davis Pond	300
St. Matthews, High Hill Creek	50
Salley, Corbitt's pond	650
Sawyer's pond	650
Vann's pond	650
Simpsonville, Woods Pond	200
Society Hill, Sumner Pond	300
Spartanburg, Fresh Creek	500
Pearson Lake	100
Swansea, Poole's pond	700
Trenton, Cogburn Pond	100
Harling's pond	100
Hatchers Pond	125
Martins Pond	100
Ropers Pond	100
Sandy Pond	100
Silver Pond	100
Ulmers, Cope's pond	50
Winnsboro, Fairfield Cotton Mill Pond	50
South Dakota:	
Hartford, Wall Lake	500
Tennessee:	
Algood, Verble's pond	100
Baxter, Rice's pond	100
Big Sandy, Davis Pond	150
Bluff City, Holston River, South Fork	1,000
Tennessee—Continued.	
Concord, Kincer's pond	200
Fayetteville, Elk River	1,000
Gallatin, Jameson's pond	100
Gates, Bain's pond	100
Lewisburg, Taylor's pond	150
Mountain City, McQueen's pond	200
Pinson, Haynes Pond	150
Rickman, Wilson's pond	150
Slayden, Gilmore's pond	100
Trenton, Baileys Pond	100
Texas:	
Abilene, Twin Lakes	100
Anson, Norman Lake	50
Arlington, Beckman's pond	200
Athens, Flag Lake	200
Atlanta, Cameron's pond	150
Bassatt, Corley's pond	100
Beeville, Beeville Substation Reservoir	100
Beckville, Browning's pond	100
Blanket, Turner's pond	50
Blossom, Furgerson's pond	50
Brady, Shuler Pond	100
Bridgeport, Lake View	50
Burton, Jaroszewsky's pond	200
Watson's pond	200
Caldwell, Fay Lake	300
Wilson Lake	800
Canadian, Todd's pond	50
Canyon City, Terra Blanca Creek	100
Carthage, Buck Pond	100
Roger's pond	50
Celina, Moore's pond	200
Channing, Cheyenne Lake	100
Chico, Kirby Creek	50
Clarendon, Renfroe's lake	50
Clarksville, McKinney Pond	20
Claude, Duffel's pond	50
Colorado, Cook's pond	50
Coolidge, Armour's pond	100
Comanche, Hill Crest Pond	50
Commerce, Looney's pond	200
Dallas, Kid Springs Pond	50
Datura, Pritchard's pond	100
Devine, Howard's 'pond	100
D'Hanis, Seco Creek	200
Eddy, Hairston's pond	100
El Campo, Moots Pond	100
Elgin, Burke's pond	50
Proschl pond	100
Elmendorf, Lander Lake	200
Estelline, Vardy's pond	50
Falfurrias, Thompson's pond	200
Fannin, Wind Mill Pond	50
Floyd, Allen Lake	350
Fluvanna, Peterson's pond	50
Franklin, Rock Hill Pond	60
Gilmer, Smart's pond	200
Goliad, Mathis's pond	50
Grand Saline, Stanford's pond	150
Grapeland, Chaffin's pond	50
Darsey's pond	200
Guice Pond	100
Greenville, Hale's pond	40
Haskell, Baldwin Lake	50
Hebbronville, Lane's pond	50
Henderson, Moss's pond	150
Shodden's pond	150
Hermleigh, Meiers Pond	50
Holland, Markham's pond	100
Hondo, Leinweber's pond	100
Hubbard, Farm Pond	100
Ganze's pond	100
Water Works Lake	200
Humble, Fondren Oil Co. Pond	50
Jefferson, Sarber Lake	300

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

SUNFISH (BREAM)—Continued.

Disposition.	Fingerlings, yearlings, and adults.
Texas—Continued.	
Kaufman, Owl Lake	100
Kemp, Garner Lake	150
McFall's pond	75
Kerrville, Heinen's pond	100
Lambdin, Indian Creek	50
Lambdin Lake	100
Mud Creek	50
Saline Creek	200
Le Roy, Cole's pond	100
Longview, Sabine Country Club Lake	600
Loraine, Edmonston's pond	50
Lufkin, City Reservoir	50
Mabank, Cany Creek	50
Cockerell's pond	150
Gibbs's pond	75
Hearn's pond	75
Sam's lake	50
Marathon, Spruce Pond	200
Marfa, Middleton's pond	50
Moss Lake	250
Thomas's pond	150
Mariana, O'Connors Pond	50
Marion, Staats's pond	400
Mexia, Felz's pond	200
Midland, Sligo Lake	100
Webb's pond	50
Mineola, Butler Lake	500
Charter Lake	500
Emory Pond	200
Rock Falls Club Lake	500
Vessy Pond	100
Morgan, Robinson's pond	50
Muldoon, Berry's lake	50
Nocona, Wilton's pond	50
Odessa, Cottonwood Pond	50
Printz's pond	50
Paris, Longs Pond	100
Williams's pond	200
Pittsburg, Ferndale Club Lake	500
Point, Simmons's pond	150
Poteet, Langunillis Reservoir	300
Pritchett, Holloway's pond	100
Purdon, Forshaw's pond	200
Putnam, Harwell Pond	200
Reagor Springs, Reagor Springs Lake	100
Rice, Wheeler's pond	150
Riviera, Boulevard Reservoir	100
Rosenberg, Blauschies's pond	250
Rotan, Fair Lake	100
Texas—Continued.	
Rotan, Terrell's pond	100
Saginaw, Big Fossill Creek	130
San Marcos, San Marcos River	550
Seagonville, Lewis's pond	50
Spofford, Hobb's pond	150
Stamford, Hughes's pond	100
Sunset, Hodge's pond	50
Tahoka, McGonagill's pond	50
Tolbert, North Pond	50
Tyler, Green Brier Lake	500
Hitts Lake	200
Massey's pond	100
Mud Creek	500
Neeches River	500
Sabine River	500
Water Works Pond	300
Whitaker's lake	200
Uvalde, Flowers's pond	50
Waco, Holland's pond	150
Lake Riverside	150
Thagard's pond	200
Weatherford, Clear Lakes	130
Silver Lake	100
Webster, Bouton's pond	100
Wichita Falls, Wichita Falls Lake	130
Virginia:	
Baskerville, Childrens Lake	200
Spring Lake	200
Beaver Dam, Rice's pond	200
Coeburn, Yates's pond	100
Dunn Loring, Lake Willowmere	100
Kenbridge, Gee's pond	100
Rutherglenn, Cashell's pond	200
The Plains, Furcron's pond	150
West Virginia:	
Berkeley Springs, Warm Springs	100
Mannington, Park's pond	100
Paw Paw, Arnica's pond	200
Shepherdstown, Potomac River	22,165
Wisconsin:	
Colfax, Big Eddy Pond	50
Lake Colfax	100
Point of Rocks Pond	50
Independence, Bugle Lake	800
New City Pond	800
Vesper, Maple River Pond	500
Washburn, Tannensee Lake	100
Total [a]	228,300

PIKE PERCH.

Disposition.	Eggs.	Fry.
Arkansas:		
Arkadelphia, Caddo River		100,000
Ouachita River		300,000
Brentwood, White River, West Fork		250,000
Sylamore, Raccoon Creek		300,000
Connecticut:		
Hadlyme, State fish commission	2,000,000	
Naugatuck, Davis Pond		500,000
Watertown, Smilter Pond		500,000
Illinois:		
Barrington, Lake Zurich		600,000
Frankfort, Hickory Creek		300,000
Hinsdale, Salt Creek		300,000
Meredosia, Meredosia Bay		200,000
Orangeville, Richland Creek		400,000

[a] Lost in transit, 790 fingerlings.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

PIKE PERCH—Continued.

Disposition.	Eggs.	Fry.
Illinois—Continued.		
Sandwich, Fox River		700,000
Thornton, Thornton Pond		300,000
Wilmington, Kankakee River		600,000
Indiana:		
Angola, Snow Lake		1,800,000
Culver, Lake Maxinkuckee		2,100,000
Fremont, Lake George		800,000
Indianapolis, Applicant	3,000,000	
Leesburg, Tippecanoe Lake		800,000
Vincennes, Robesons Lake		800,000
Iowa:		
Chester, Upper Iowa River		400,000
Lime Springs, Upper Iowa River		400,000
Randall, Little Wall Lake		400,000
Staceyville, Little Cedar River		400,000
Kansas:		
Paola, Bull Creek		150,000
Kentucky:		
Barbourville, Cumberland River		600,000
Burnside, Cumberland River, Tributary		500,000
Jackson, Kentucky River, North Fork		400,000
Pikeville, Big Sandy River		500,000
Mount Sterling, Slate Creek		400,000
Maryland:		
Baltimore, Herring Pond		200,000
Hancock, Potomac River		500,000
Middle River, Middle River		200,000
Washington Junction, Monocacy River		200,000
Washington Junction, Potomac River		200,000
Massachusetts:		
Greenfield, Connecticut River		1,000,000
Huntington, Norwich Pond		1,500,000
Michigan:		
Algonac, St. Clair River		2,500,000
Bay City, Saginaw Bay		1,500,000
Clyde, Fish Lake		500,000
Detroit, Detroit River		3,000,000
Jackson, Spring Arbor Mill Pond		500,000
St. Joseph, Chapin Lake		2,000,000
Minnesota:		
Jenkins, Stony Lake		390,000
Whitefish Lake		520,000
Lanesboro, Root River		100,000
Root River, North Branch		100,000
Root River, South Branch		75,000
Le Claire Point, Lake of the Woods		240,000
Missouri:		
Brownwood, Castor River		350,000
Cabool, Piney River		200,000
Lebanon, Niangua River		350,000
St. Joseph, State fish commission	17,000,000	
New Hampshire:		
Center Ossipee, Ossipee Lake		800,000
Claremont, Crescent Lake		500,000
Winchester, Forest Lake		500,000
New Jersey:		
Hackettstown, Allamuchy Pond		300,000
Hoboken, Lake Hopatcong		2,450,000
Rockaway, Shongum Pond		300,000
New York:		
Addison, Canisteo River		1,000,000
Cambridge, Lake Lauderdale		500,000
Schoolhouse Pond		500,000
Carleton Island, St. Lawrence River		3,000,000
Grass Bay, St. Lawrence River		3,000,000
Highland Falls, Cranberry Lake		500,000
Popolopen Lake		500,000
Monticello, Kiamesha Lake		1,000,000
Mud Creek, Lake Ontario		2,000,000
New York, New York Aquarium	1,000,000	
Ravenna, Ravenna Reservoir		500,000
Troy, Hudson River		1,000,000
Walden, Wallkill River		600,000
Wayland, Loon Lake		1,500,000
Ohio:		
Antwerp, Maumee River		600,000
Cary, Tymochtee Creek		200,000
Kellys Island, Lake Erie		10,000,000
Lake View, Indian Lake		1,000,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

PIKE PERCH—Continued.

Disposition.	Eggs.	Fry.
Ohio—Continued.		
Middle Bass Island, Lake Erie		9,600,000
Oak Harbor, Portage River		600,000
Port Clinton, Lake Erie		10,000,000
Put-in Bay, State fish commission	101,500,000	
Pennsylvania:		
Canton, Lake Napahwin		1,000,000
Eagles Mere, Eagles Mere Lake		1,000,000
Echo Lake, Echo Lake		600,000
Lewistown Junction, Juniata River		300,000
Mount Union, Juniata River		300,000
Newport, Big Buffalo Creek		200,000
Little Buffalo Creek		200,000
Susquehanna, Susquehanna River		1,000,000
Tionesta, Alleghany River		800,000
South Dakota:		
Alexandria, James River		400,000
Britton, Clear Lake		100,000
Langford, Four Mile Lake		150,000
Red Iron Lake		150,000
Madison, Lake Madison		150,000
Vermillion, Charrlins Lake		400,000
Volga, Lake Oakwood		150,000
Lake Tetonkaha		150,000
Tennessee:		
Sedalia, Mulberry Creek		500,000
Powels River		400,000
Vermont:		
Brandon, Lake Hortonia		1,000,000
Brattleboro, Wantastiket Lake		1,000,000
Burlington, Lake Champlain		250,000
Concord, Hall's pond		500,000
Greensboro, Long Pond		1,000,000
Lunenburg, Neals Pond		500,000
Miles Pond, Miles Pond		500,000
Newport, Pensioners Pond		500,000
North Ferrisburg, Lewis Creek		2,000,000
Rocky Point, Groton Pond		800,000
Rutland, Lake Bomoseen		1,000,000
Swanton, Lake Champlain		15,000,000
Missisquoi River		65,350,000
Vergennes, Little Otter Creek		2,000,000
Otter Creek		2,000,000
Walden, Coles Pond		500,000
Wallis Pond, Wallis Pond		500,000
Wells River, Wells River		1,000,000
West Danville, Joe's pond		1,000,000
West Milton, La Moille River		10,000,000
Virginia:		
Courtland, Nottoway River		500,000
Danville, Dan River		700,000
Sandy River		400,000
Emporia, Fountain Creek		300,000
Front Royal, Shenandoah River		300,000
Strasburg, Shenandoah River		300,000
West Virginia:		
Buchannon, Buchannon River		500,000
Charleston, Elk River		1,000,000
Gassaway, Elk River		1,000,000
Romney, Potomac River, South Branch		500,000
Wisconsin:		
Baraboo, Devils Lake		200,000
Colfax, Lake Colfax		225,000
Elkhart Lake, Crystal Lake		175,000
La Crosse, Chamberlain Creek		50,000
Crosby Creek		50,000
Dark Creek		50,000
French Lake		100,000
Joe Lynn Creek		50,000
Log Chute Creek		50,000
Lytles Bay Creek		50,000
Spring Creek		50,000
Swift Creek		50,000
Wigwam Creek		50,000
Mercer, Trude Lake		1,000,000
Okauchee, Okauchee Lake		400,000
Random Lake, Random Lake		175,000
Rib Lake, Spirit Lake		200,000
Stevens Point, Wisconsin River		500,000
Taylor Lake, Taylor Mill Pond		225,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

PIKE PERCH—Continued.

Disposition.	Eggs.	Fry.
Wisconsin—Continued.		
Tomahawk, Somo River		200,000
Turtle Lake, Horseshoe Lake		100,000
Little Horseshoe Lake		100,000
Little Round Lake		75,000
Wausau, Big Rib River		150,000
Half Moon Lake		100,000
Lake Wausau		100,000
Little Rib River		150,000
Wisconsin River		100,000
Total[a]	122,500,000	208,950,000

PIKE.

Disposition.	Fingerlings, yearlings, and adults.
Arkansas:	
Helena, Mississippi River	115
Iowa:	
Bellevue, Mississippi River	4,255
North McGregor, Mississippi River	50
Total	4,420

YELLOW PERCH.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Colorado:			
Boulder, Harlow Lake			450
Wray, Rose Lake			300
Connecticut:			
Hadlyme, State fish commission	5,000,000		
Torrington, Bantam Lake		500,000	
Illinois:			
Benton, Seeber's pond			400
Carlinville, Cooney's pond			200
Christopher, North Mine Ponds			400
Manhattan, Bickford Quarry Pond			175
Iowa:			
Bellevue, Mississippi River			930
Glenwood, City Park Lake			275
Shenandoah, Moody's pond			100
Kansas:			
Garnett, Cedar Creek			600
Maryland:			
Accokeek Creek, Potomac River		90,435,500	
Broad Creek, Potomac River		3,000,000	
Bush River, Bush River		15,000,000	
Elkton, Elk River		4,500,000	
Furnace, Furnace Creek		6,000,000	
Gunpowder, Gunpowder River		5,000,000	
Harford, Swan Creek		26,000,000	
Harmony Grove, Richfield Pond		100,000	
Havre de Grace, Bohemia River		10,000,000	
Chesapeake Bay		144,000,000	
North East River		21,000,000	
Spesutie Narrows		36,000,000	
McDaniel, Lovers Cove Pond		200,000	
Pamunkey Creek, Potomac River		4,714,025	
Piscataway Creek, Potomac River		40,870,500	
Robinsons Station, Severn River		400,000	
Massachusetts:			
Congamond, Congamond Lakes		500,000	
Greenfield, Deerfield Creek		1,000,000	

[a] Lost in transit, 300,000 fry.

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

YELLOW PERCH—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Missouri:			
Pleasant Hill, Kellogg Lakes			200
St. Joseph, State fish commission	2,500,000		
New Jersey:			
Gillette, Passaic River		600,000	
Princeton, Carnegie Lake		795,000	
New York:			
Battery Park, New York Aquarium	1,000,000		
Camden, Fish Creek			80
Cape Vincent, St. Lawrence River		50,000	
Fallsburgh, Ruddicks Pond			120
Lockport, Red Creek			375
Schenectady, Mohawk River			70
Veeders Pond			30
Walden, Wallkill River		600,000	
North Carolina:			
Henderson, Harris Pond			50
Stovall, Gregory Pond			50
Oklahoma:			
Mountain Park, Bermuda Lake			100
Pennsylvania:			
Brackney, Quaker Lake			80
Brookdale, Durwent Water			500
Stroudsburg, Lake Maskenozha		800,000	
Mance, Bauman's pond		100,000	
Becker's dam		100,000	
New Berlin, Maurers Pond			80
Saxton, Raystown Branch		400,000	
Wellsboro, Charleston Creek			90
Vermont:			
Brandon, High Pond		500,000	
Burlington, Lake Champlain		160,000	
Hog Island, Lake Champlain		1,000,000	
Joes Pond, Lake St. Joseph		1,000,000	
Lyndonville, Bean Pond		500,000	
Chandler Pond		500,000	
Pasture Pond		500,000	
Swanton, Missisquoi River		1,600,000	
Virginia:			
Butterworth, Butterworth Pond		200,000	
Dogue Creek, Potomac River		16,697,300	
Elkton, Shenandoah River		500,000	
Harrisonburg, Muddy Creek		800,000	
Lake, Coan Pond		100,000	
Little Hunting Creek, Potomac River		13,963,475	
New Market, Smith Creek		300,000	
Norfolk, Pleasure Lake		200,000	
Petersburg, Branders Pond		300,000	
Pohick Creek, Potomac River		21,998,795	
Richmond, Association Pond		200,000	
Stony Creek, Chappelle's mill pond		300,000	
Suffolk, Lake Tranquil		300,000	
West Virginia:			
Shepherdstown, Potomac River			65
Wisconsin:			
Bangor, Larsons Lake			100
Neshonoc Pond			100
Total [a]	8,500,000	474,284,595	5,920

STRIPED BASS.

Disposition.	Fry.
North Carolina:	
Columbia, Scuppernong River	500,000
Washington, Pamlico River	800,000
Weldon, Roanoke River	3,556,000
Virginia:	
Norfolk, Tanners Creek	500,000
Total	5,356,000

[a] Lost in transit, 25 fingerlings and 645,000 fry.

Distribution of Fish and Eggs, Shown by Locality and Species, for Fiscal Year 1912—Continued.

WHITE PERCH.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
Connecticut:			
Danbury, Balls Pond		500,000	
Lake Kenosia		500,000	
West Lake		500,000	
Deep River, State fish commission	15,000,000		
East Hampton, Lake Pocotopang		500,000	
Hawleyville, Tawnton Pond		500,000	
Maine:			
North Berwick, Banneg Beg Lake		1,000,000	
Walker, Squawpan Lake		2,500,000	
Maryland:			
Bush River Station, Bush River		6,000,000	
Elk River, Chesapeake Bay		10,000,000	
Furnace, Chesapeake Bay		64,000,000	
Great Falls, Potomac River			670
Gunpowder Station, Gunpowder River		5,000,000	
Havre de Grace, Chesapeake Bay		182,400,000	
Locust Point, Chesapeake Bay		20,000,000	
North East River, Chesapeake Bay		20,400,000	
Piney Point, Piney Point Creek		600,000	
Port Deposit, Chesapeake Bay		6,000,000	
Robinsons Station, Severn River		1,000,000	
Spesutie Narrows, Chesapeake Bay		23,900,000	
Swan Creek, Chesapeake Bay		45,900,000	
Potomac River		36,500,000	
Town Point, Elk River		5,000,000	
Massachusetts:			
Fitchburg, Ward Pond		500,000	
Whalom Lake		750,000	
Forge Village, Forge Pond		1,000,000	
Lake Boone, Lake Boone		750,000	
North Dana, Lake Neeseponset		500,000	
New Hampshire:			
Alton, Half Moon Pond		750,000	
Hillsboro, Millen Lake		750,000	
Keene, Spofford Lake		750,000	
Littleton, Partridge Lake		500,000	
Manchester, Long Pond		500,000	
Pike, Lake Tarleton		1,750,000	
Sanbornville, Lovell Lake		750,000	
Winchester, Forest Lake		750,000	
Wolfeboro, Lake Wentworth		750,000	
Mirror Lake		500,000	
New Jersey:			
Branchville, Culver Lake		600,000	
New York:			
Walden, Wallkill River		600,000	
Westchester, Browns Pond		500,000	
Rhode Island:			
Harrisville, Herring Pond		250,000	
Kingston, Barber's pond		1,000,000	
Nayatt, Long Pond		500,000	
Vermont:			
Bennington, Barbers Pond		500,000	
Benton Pond		500,000	
Lake Hancock		500,000	
Mud Pond		500,000	
Woodford Big Pond		500,000	
Hardwick, Lake Greenwood		750,000	
Montpelier, Sabin Pond		500,000	
Rocky Point, Groton Lake		750,000	
St. Albans, Lake Champlain		1,000,000	
Total	15,000,000	452,900,000	670

SMELT.

Maine:			
Otis, Green Lake		6,575,000	
Maryland:			
Great Falls, Potomac River			100,650
Michigan:			
Detroit, State fish commission	20,400,000		
New Hampshire:			
Pike, Lake Armington		1,000,000	
Lake Katherine		1,000,000	
Lake Tarleton		1,000,000	

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

SMELT—Continued.

Disposition.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New York:			
Battery Park, New York Aquarium	250,000		
Sabattis, applicant	5,000,000		
Vermont:			
Readsboro, applicant	500,000		
West Barnett, applicant	500,000		
Wisconsin:			
Hudson, applicant	1,000,000		
Total	27,650,000	9,575,000	100,650

WHITE BASS.

Disposition.	Fingerlings, yearlings, and adults.
Illinois:	
Benton, Freemans Pond	120
Iowa:	
Bellevue, Mississippi River	680
Lansing, Mississippi River	100
North McGregor, Mississippi River	600
Total	1,500

FRESHWATER DRUM.

Arkansas:	
Helena, Mississippi River	7,280
Iowa:	
Bellevue, Mississippi River	1,940
Lansing, Mississippi River	1,000
North McGregor, Mississippi River	1,500
Total	11,720

COD.

Disposition.	Fry.
Maine:	
Boothbay Harbor, Boothbay Harbor	2,940,000
Linekin Bay	2,552,000
East Boothbay, Linekin Bay	738,000
Massachusetts:	
Beverly, Massachusetts Bay	15,130,000
Falmouth, Buzzards Bay	1,178,000
Great Harbor	21,380,000
Nantucket Sound	5,454,000
Quissett Harbor	860,000
Vineyard Sound	2,087,000
Gloucester, Atlantic Ocean	12,310,000
Ipswich Bay	2,230,000
Massachusetts Bay	1,190,000
Gosnold, Buzzards Bay	4,302,000
Nantucket Sound	174,000
Vineyard Sound	42,811,000
Manchester, Massachusetts Bay	11,950,000
Rockport, Atlantic Ocean	5,800,000
Tarpaulin Cove, Vineyard Sound	103,742,000
Woods Hole, Eel Pond	295,000
Total	237,123,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

POLLOCK.

Disposition.	Fry.
Massachusetts:	
Beverly, Massachusetts Bay	39,960,000
Essex, Ipswich Bay	6,000,000
Gloucester, Atlantic Ocean	48,560,000
Ipswich Bay	36,520,000
Massachusetts Bay	22,670,000
Marblehead, Massachusetts Bay	26,600,000
Manchester, Massachusetts Bay	46,340,000
Rockport, Atlantic Ocean	21,550,000
Ipswich Bay	40,220,000
Tarpaulin Cove, Vineyard Sound	1,950,000
Total	290,370,000

HADDOCK.

Disposition.	Fry.
Maine:	
Boothbay Harbor, Boothbay Harbor	11,316,000
Massachusetts:	
Beverly, Massachusetts Bay	11,200,000
Gloucester, Atlantic Ocean	33,700,000
Ipswich Bay	14,130,000
Gosnold, Vineyard Sound	2,447,000
Rockport, Atlantic Ocean	13,360,000
Ipswich Bay	9,000,000
Total	95,153,000

FLATFISH.

Disposition.	Fry.
Maine:	
Boothbay, Sheepscot River	30,560,000
Boothbay Harbor, Boothbay Harbor	196,298,000
Linekin Bay	95,462,000
Townsend Gut	11,460,000
East Boothbay, Christmas Cove	19,098,000
Linekin Bay	71,375,000
Southport, Ebencook Harbor	19,334,000
Pig Cove	12,472,000
Townsend Gut	11,460,000
West Boothbay Harbor, West Boothbay Harbor	22,650,000
Massachusetts:	
Beverly, Massachusetts Bay	41,550,000
Falmouth, Buzzards Bay	16,419,000
Great Harbor	5,172,000
Nantucket Sound	35,852,000
Quissett Harbor	16,323,000
Gloucester, Annisquam River	28,100,000
Massachusetts—Continued.	
Gloucester, Ipswich Bay	25,000,000
Gloucester Harbor	86,640,000
Gosnold, Buzzards Bay	19,784,000
Lackeys Bay	10,233,000
Nantucket Sound	48,807,000
Manchester, Massachusetts Bay	32,680,000
Nobska Point, Nantucket Sound	7,333,000
Rockport, Ipswich Bay	39,860,000
Rockport Harbor	12,380,000
Salem, Salem Harbor	7,000,000
Tarpaulin Cove, Vineyard Sound	341,000
Waquoit, Waquoit Bay	2,680,000
Rhode Island:	
Wickford, Narragansett Bay	24,650,000
Wickford Harbor	14,476,000
Total	965,449,000

LOBSTER.

Maine:	
Biddeford Pool, Biddeford Pool	5,000,000
Wood Island Harbor	5,000,000
Boothbay, Boothbay Harbor	6,000,000
Boothbay Harbor, Boothbay Harbor	8,795,000
Linekin Bay	9,500,000
Townsend Gut	2,000,000
Bristol, Johns Bay	6,000,000
Brooklyn, Eggemoggin Reach	1,000,000
Grays Cove	1,000,000
Camden, Camden Harbor	125,000
Lazells Island Harbor	125,000
Cape Porpoise, Cape Porpoise Harbor	4,000,000
Corea, Gouldsboro Bay	2,125,000
Cranberry Isle, Isleford Harbor	3,250,000
Damariscotta, Damariscotta River	2,000,000
Maine—Continued.	
Deer Isle, Southwest Harbor	250,000
Stonington Harbor	3,000,000
Swain's cove	500,000
Eagle, West Penobscot Bay	750,000
Eastport, Shackford Cove	4,000,000
East Boothbay, Linekin Bay	5,000,000
East Stuban, Pigeon Hill Bay	2,000,000
Ellsworth, Union River	1,000,000
Freeport, Casco Bay	4,000,000
Friendship, Delanoe Cove	2,000,000
Friendship Harbor	4,500,000
Georgetown, Five Islands Harbor	2,000,000
Goose Rock Passage	3,000,000
Harmans Harbor	1,000,000
Goose Harbor, Gulf of Maine	1,000,000
Gouldsboro, Prospect Harbor	4,750,000

DISTRIBUTION OF FISH AND EGGS, SHOWN BY LOCALITY AND SPECIES, FOR FISCAL YEAR 1912—Continued.

LOBSTER—Continued.

Disposition.	Fry.	Disposition.	Fry.
Maine—Continued.		Maine—Continued.	
Isle of Shoals, Isle of Shoals Harbor.	2,000,000	Swans Island, Mintuan Harbor	500,000
Jonesport, Cape Split Harbor	2,000,000	Old Harbor	2,000,000
Englishmans Bay	2,000,000	Tenant Harbor, Wheelers Bay	5,000,000
Kennebunkport, Kennebunkport Harbor	2,000,000	Vinal Haven, Penobscot Bay	250,000
Kittery, Pepperell Cove	2,000,000	Vinal Haven Harbor	7,500,000
Kittery Harbor, Gulf of Maine	500,000	Wells, Wells Bay	2,000,000
Lincolnville, Lincolnville Harbor	125,000	York Harbor, York Harbor	4,000,000
Long Island, Frenchboro Harbor	250,000	New Hampshire:	
Machiasport, Northeast Harbor	2,000,000	Hampton, Hampton Harbor	4,000,000
Northwest Harbor	2,000,000	Hampton Harbor, Gulf of Maine	500,000
Starboard Isle Harbor.	2,000,000	New Castle, Little New Harbor	2,000,000
Mount Desert, Bass Harbor	2,000,000	Rye Harbor, Gulf of Maine	500,000
Duck Harbor	500,000	Massachusetts:	
Millbridge, Dyer Bay	1,000,000	Annisquam, Annisquam River	400,000
New Harbor, New Harbor	3,000,000	Bay View, Ipswich Bay	500,000
North Haven, Crocketts River	1,000,000	Beverly, Massachusetts Bay	1,000,000
North Haven Harbor.	2,000,000	Boston, Boston Harbor	2,000,000
Ogunquit, Perkins Cove	2,000,000	Devils Foot Passage, Great Harbor	692,000
Orrs Island, Quahog Bay	1,000,000	Falmouth, Great Harbor	242,000
Pemaquid, Johns Bay	3,500,000	Gloucester, Annisquam River	800,000
Pulpit, Marsh Cove	125,000	Atlantic Ocean	2,825,000
Pulpit Harbor	250,000	Gloucester Harbor	825,000
Rockland, Rockland Harbor	500,000	Ipswich Bay	900,000
Rockport, Rockport Harbor	500,000	Grassy Island, Great Harbor	549,000
St. George, Metinic Island Harbor	2,000,000	Great Harbor, Great Harbor	451,000
Port Clyde Harbor	3,000,000	Hull, Hingham Bay	500,000
Seal Harbor, Seal Harbor	500,000	Manchester, Massachusetts Bay	1,850,000
Sorrento, Frenchmans Bay	125,000	Marblehead, Massachusetts Bay	1,950,000
South Addison, Wass Cove	1,000,000	Menemsha Light, Vineyard Sound	353,000
South Bristol, Christmas Cove	3,000,000	Robinson Hole, Buzzards Bay	786,000
South Hancock, Frenchmans Bay	3,000,000	Rockport, Atlantic Ocean	700,000
Southport, Ebencook Harbor	6,500,000	Ipswich Bay	900,000
Marrs Harbor	1,000,000	Rockport Harbor	500,000
Pig Cove	1,000,000	Salem, Massachusetts Bay	500,000
South Thomaston, Seal Harbor	2,000,000	Tarpaulin Cove, Vineyard Sound	210,000
Swan Isle, Mackerel Cove	2,000,000	Total	201,728,000

IDENTIFICATION OF THE GLOCHIDIA OF FRESHWATER MUSSELS

By Thaddeus Surber

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Fairport, Iowa

Bureau of Fisheries Document No. 771

IDENTIFICATION OF THE GLOCHIDIA OF FRESHWATER MUSSELS.

By Thaddeus Surber,
Assistant, U. S. Biological Laboratory, Fairport, Iowa.

While carrying on experiments in the artificial infection of fishes with the glochidium larvæ of freshwater mussels at the Fairport Biological Laboratory, the question of suitable hosts for the various species arose almost at the beginning of the work; for while we were quite successful with certain species others gave but very indifferent results. This naturally led to search for natural hosts of the various species, during which it became necessary to examine the gills and fins of many fishes, a work which, though it has in reality only begun, is already fruitful in results and opens up a wide field for research. In fact, the artificial propagation of the mussel depends to a certain extent upon these results; and my object in writing this paper at the present time is to stimulate such investigation, which will amply reward those who care to take it up.

The identification of the various species while in a parasitic stage presents some difficulties. The only available figures of glochidia, so far as I know, are those made by Lea,[a] who figures a great many species, but not very accurately as to relative size, etc., and his figures are therefore of little use. Lately Lefevre and Curtis have given some most excellent figures, with measurements, but the species are few.

The requisite is a complete collection of the various species carefully mounted, from which proper camera-lucida drawings can be made to a uniform scale. Such a collection has been attempted in the present undertaking, and the figures submitted herewith represent about 40 species, most of them forms occurring in the Mississippi River in the vicinity of Fairport, but supplemented by a few from the Cumberland River, the Ohio, and a few other points where investigations have been carried on by Mr. H. Walton Clark, the late J. F. Boepple, and myself.

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[a] Lea, Isaac: Description of the embryonic forms of 38 species of Unionidæ. Journal Academy of Natural Sciences Philadelphia, 2d ser., vol. IV, pl, 5; Description of 52 species of Unionidæ, ibid., vol. VIII, supplement, pl. 21.

In order to secure uniform results uniformity in the preparation of the material is of the first importance. The method of procedure, therefore, briefly stated, was throughout as follows: A section of the mussel gill, if large, or the entire gill, if small, is first carefully removed and killed in 10 per cent formalin, in which it is allowed to remain a few hours. The section is then carried through alcohols of increasing strength up to 70 per cent, when the glochidia are teased out and stained in eosin or cochineal, the latter stain being the most satisfactory in most cases, after which hardening is carried slowly up to 95 per cent alcohol. Oil of cloves has proved to be the most satisfactory clearing agent, xylol being too violent in its action. Mounts are made in Canada balsam. The same method has been pursued in preparation of fish gills bearing natural infection in order to produce uniform results. This method gives preparations of glochidia in which the valves of the shell are closed, but if they are desired expanded, then the method used by Lefevre and Curtis [a] is recommended of slowly introducing crystals of cocaine or chloral hydrate into a watch glass containing the larvæ.

It is not desirable to go into detail in the description of the glochidium, as it is believed reference to the analytical key and the figures themselves will do more to make the differences apparent than pages of descriptive matter. The importance of the glochidium in the classification of the Unionidæ is recognized, but to try to show the relationship of the different genera and species at this time with our present lack of material would be unsafe, to say the least. At the present time it will be best to call the reader's attention to a few important points only.

It has been ascertained that variation in size is comparatively slight in a given species, except in one instance, where some glochidia of *L. luteola* from Clear Lake, Iowa, were found to be uniformly smaller than those of the same species taken in the Cedar River, but, as the adult shells from this lake are very small and thin-shelled as compared with those from the Cedar River, the difference in size of the larval mussel may be correlated. There was, however, in this case no apparent difference in the shape or proportions of the glochidia from the two sources.

Drawings have been made of what might be safely considered as typical specimens, except in the case of *Cyprogenia irrorata* (fig. 11, pl. I) and *Quadrula heros* (fig. 32, pl. II), where the only material available was not quite mature, although advanced sufficiently in development to give a most excellent idea of the subsequent shape and size.

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[a] Studies on the reproduction and artificial propagation of freshwater mussels. By George Lefevre and Winterton C. Curtis. Bulletin Bureau of Fisheries, vol. XXX, p. 150.

While all the species figured are not of uniform development, no change of form nor increase in size would occur, except as above noted. For instance, *S. costata* (fig. 7, pl. I) is more developed than *L. subrostrata* (fig. 16, pl. II), and this again is greatly advanced over *Q. granifera* (fig. 19), the anterior and posterior adductor muscles having become completely separated in *costata*, less so in *subrostrata*, and just beginning to separate in *granifera*. The shape and relative position of the adductor muscle before separation is a uniform feature for each species, and its importance as an aid to identification should not be overlooked.

Sterki [a] some years ago (1903) pointed out the character of the glochidium as an important factor in the classification of the Unionidæ, and this is clearly confirmed in the case of *L. anodontoides* and *L. fallaciosa*, the adult shells being very often inseparable, in fact, their identification as separate species even under the most favorable circumstances being difficult. When we come to examine the glochidia, however, we find that there is not only a difference in form but also in size, *L. anodontoides* (fig. 21, pl. II) being smaller and slightly shorter in proportion to its depth than *L. fallaciosa* (fig. 22, pl. II).

Owing to the small size of the glochidium of *L. gracilis*, and, notwithstanding its affinity with *L.* (*Proptera*) *alata* in the structure of the soft parts of the adult animal, Ortmann [b] (1911) created for it a new genus—*Paraptera*. If size and general shape alone were the controlling factors then the very minute glochidium of both *Plagiola donaciformis* (fig. 29, pl. II) and *P. elegans* (fig. 30, pl. II) would place them with *gracilis* were it not for the gaping margins of the glochidial shell in *gracilis*,[c] in which respect it resembles *P. securis*. The position of these two forms (*donaciformis* and *elegans*), in my opinion, remains in doubt, and the acquisition of more material, with careful study, will probably reveal much of interest in relation to these small mussels.

It is unfortunate that more is not known as to the period during which the Unionidæ are gravid, or rather as to when they carry well-developed glochidia. Unfortunately investigators are not in the habit of giving us uniform data in this respect, the term "gravid" having too wide a range of meaning and including too often mussels which we may designate as bearing early embryos, late embryos, or glochidia. In the case of the short-period breeders it does not matter so much, for the period is so brief—a month, or two months at most—that some fair idea may be formed of the date on which to expect

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[a] Sterki, V.: Notes on the Unionidæ and their classification. American Naturalist, vol. 37, p. 103.

[b] Ortmann, A. E.: A monograph of the Najades of Pennsylvania. Memoirs of the Carnegie Museum, vol. IV, p. 334.

[c] Coker, R. E., and Surber, T.: A note on the metamorphosis of the mussel Lampsilis lævissimus. Biological Bulletin, vol. XX, p. 180, and pl. 1, fig. 2a.

glochidia. And, again, these short-period breeders, particularly several of the *Quadrulas*, may have in the marsupium at the same time embryos in all stages from the earliest on up to those with perfectly developed glochidial shells. As an instance of the more or less confused state of our present knowledge of the breeding periods of the different forms, in the tables of "periods of gravidity" to follow I have placed *Quadrula heros* among the long-period species, but, I must admit, with considerable hesitation. As pointed out by Lefevre and Curtis (1912),[a] Frierson found it gravid in Louisiana in October (embryos), again in November, and immature glochidia in January, while their own observations record the occurrence of early embryos in May. The late J. F. Boepple found it gravid (immature glochidia) in the Ohio River in October and November.

Lefevre and Curtis give *Plagiola elegans* as one of the long-period breeders, and probably this is correct, but the only times at which we have found them gravid at Fairport, or elsewhere, are during May and July. Both early embryos and glochidia have been found in *P. donaciformis* during July, but at no other time, so that with our meager knowledge of these forms it seems rather risky to include them among the long-period breeders at the present time.

In the following tables of gravidity it should be borne in mind that records are for months during which it is known the species bear glochidia of sufficient development to begin their parasitic life, except in the case of *Quadrula heros* and *Cyprogenia irrorata*, as previously shown.

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[a] Op. cit., Bulletin of the Bureau of Fisheries, vol. xxx, p. 144.

Species with long period of gravidity.

Species.	Month in which found bearing glochidia.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Alasmidonta truncata												
calceolus[a]												
Anodonta corpulenta				×							×	
grandis									×	×		
imbecillis			×			×	×	×				
Anodontoides ferussacianus subcylindraceus									×			
Arcidens confragosus											×	
Cyprogenia irrorata[b]										×	×	
Dromus dromus										×		
Lampsilis alata			×		×	×	×	×	×	×	×	
anodontoides			×	×	×	×	×	×			×	
capax						×	×	×				
fallaciosa											×	
gracilis	×					×	×	×		×	×	
higginsi					×				×			
iris									×			
lævissima				×		×			×			
ligamentina		×	×	×	×	×	×		×	×	×	×
luteola				×					×			
recta			×	×	×		×		×	×	×	
subrostrata										×		
trabalis[b]											×	
ventricosa		×		×	×		×		×		×	
Obovaria ellipsis		×			×	×			×	×		×
retusa									×			
Plagiola securis		×			×	×					×	
Quadrula heros									×	×	×	
Strophitus edentulus			×	×	×	×		×	×	×	×	
Symphynota complanata					×					×	×	
compressa									×			
costata									×			
Truncilla sulcata									×	×		

[a] From specimens taken by Mr. Clark in the Yellow River, Ind.
[b] From specimens taken by Clark and Boepple in the Cumberland River, Ky. and Tenn.

Species with short period of gravidity.

Species.	Month in which found bearing glochidia.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Obliquaria reflexa					×	×	×	×				
Pleurobema æsopus					×	×	×					
Quadrula ebena					×	×	×	×				
granifera							×					
metanevra					×	×	×					
plicata						×	×	×				
pustulata						×	×					
pustulosa						×	×					
solida					×							
trigona						×	×	×				
Tritogonia tuberculata				×[a]	×	×[a]						
Unio gibbosus						×	×	×				

[a] Ohio River records by Mr. Boepple.

While it is not my intention to take up the question of the metamorphosis of the glochidium while parasitic on the gills, or fins, of the fish, it is advisable to make brief reference to the record by Coker and Surber (1911) [a] of the growth of *L. lævissima* supplemented here with a similar record for *P. donaciformis*. The sheepshead (*Aplodinotus*

[a] Op. cit., Biological Bulletin, vol. xx, p. 179–182, pl. 1.

grunniens), from its food habits, is oftener found infected with glochidia than probably any other fish; specimens of this fish taken August 9, 1910, from which the figure shown was made (fig. 41, pl. III), and again July 20, 1911, have been found to be the hosts for many young mussels (*P. donaciformis*), all deeply encysted on the gill filaments and showing the same remarkable growth found in *lævissima*. By reference to the figure (fig. 41, pl. III) it will be noted that the growth is extraordinary, the length having increased during parasitism more than five times over the length of the glochidial shell, and with increase in depth in proportion.

As pointed out by Lefevre and Curtis [a] in various species studied by them the normal growth during the parasitic period is very slight, so far as the shell is concerned; "the mussel leaves the fish with only a very narrow margin of adult shell protruding beyond the glochidial outline. The shape is still that of the glochidium, * * *." Experiments conducted by the writer at the Fairport laboratory confirm this in the case of *L. recta*, *L. anodontoides*, and *Obovaria ellipsis*, in which scarcely any marginal growth at all is discernible.

In the key for identification of the species of unionid glochidia, which follows, the average measurements of the glochidium, in fractions of a millimeter, are given immediately following the name of each species. The length, a line across the widest part of the shell (anterior to posterior edge) parallel to the hinge line, is given first, followed by the depth, which is a vertical line from the highest point of the hinge to the extreme ventral margin. These measurements are followed by reference to figure numbers of specimens shown on the plates, an arrangement which it is hoped will facilitate the use of the figures in identification.

Key for Identification of Unionid Glochidia.

Anodonta type:

Glochidium large, subtriangular in shape, usually longer than deep, with a spine at tip of each valve.

1. Hinge line straight, or nearly so.
    - *a*. Length greater than depth.
        - *Alasmidonta calceola*, 0.300 by 0.255 mm. (fig. 1).
        - *Anodonta imbecillis*, 0.310 by 0.290 mm. (fig. 2).
        - *Strophitus edentulus*, 0.350 by 0.285 mm. (fig. 3).
        - *Symphynota compressa*, 0.353 by 0.313 mm. (fig. 44).
    - *b*. Length and depth about equal.
        - *Anodonta grandis*, 0.410 by 0.420 mm. (fig. 45).
        - *Anodontoides f. subcylindraceus*, 0.330 by 0.330 mm. (fig. 43).
2. Hinge line irregular, undulate.
    - *aa*. Length and depth almost equal.
        - *Anodonta corpulenta*, 0.350 by 0.350 mm. (fig. 4).
        - *Arcidens confragosus*, 0.355 by 0.350 mm. (fig. 5).

[a] Op. cit., Bulletin of the Bureau of Fisheries, vol. XXX, p. 176.

aaa. Depth greater than length.

Symphynota complanata, 0.310 by 0.320 mm. (fig. 6).
Symphynota costata, 0.385 by 0.390 mm. (fig. 7).
Alasmidonta truncata, 0.350 by 0.380 mm. (fig. 42).

PROPTERA TYPE:

Glochidium varying greatly in size in the different species; axe-head shape; with two spines, one at each of the ventral corners of the shell, or spineless.

1. Glochidium with spines.

a. Size large.

Lampsilis alata, 0.220 by 0.380 mm. (fig. 8).

aa. Size rather small.

Lampsilis capax, 0.105 by 0.185 mm. (fig. 9).

2. Glochidium without spines (?).

aaa. Size small.

Lampsilis lævissima, 0.100 by 0.155 mm. (fig. 10).

LAMPSILIS TYPE:

Glochidium semicircular, or semi-elliptical; ventral margin rounded; no spines present.

1. Glochidium semi-elliptical; ventral margin rounded.

a. Hinge line short and evenly curved, or undulate.

b. Size large.

Plagiola securis, 0.230 by 0.330 mm. (fig. 14).
Lampsilis iris, 0.240 by 0.300 mm. (fig. 46.)
Lampsilis luteola, 0.250 by 0.290 mm. (fig. 15).
Lampsilis subrostrata, 0.270 by 0.330 mm. (fig. 16).
Lampsilis recta, 0.220 by 0.280 mm. (fig. 17).
Lampsilis ligamentina, 0.220 by 0.260 mm. (fig. 18).
Obovaria retusa, 0.240 by 0.295 mm. (fig. 47.)
Quadrula granifera, 0.290 by 0.355 mm. (fig. 19).
Quadrula pustulosa, 0.230 by 0.290 mm. (fig. 20).

bb. Size medium.

Lampsilis anodontoides, 0.185 by 0.210 mm. (fig. 21).
Lampsilis fallaciosa, 0.200 by 0.240 mm. (fig. 22).
Lampsilis higginsi, 0.210 by 0.260 mm. (fig. 23).
Lampsilis trabalis, 0.193 by 0.255 mm. (fig. 40).
Lampsilis ventricosa, 0.205 by 0.255 mm. (fig. 24).
Obovaria ellipsis, 0.210 by 0.265 mm. (fig. 25).
Quadrula metanevra, 0.175 by 0.200 mm. (fig. 26).
Quadrula pustulata, 0.200 by 0.250 mm. (fig. 27).

bbb. Size very small.

Lampsilis gracilis, 0.070 by 0.095 mm. (fig. 28).
Plagiola donaciformis, 0.060 by 0.063 mm. (fig. 29).
Plagiola elegans, 0.060 by 0.070 mm. (fig. 30).

aa. Hinge line straight, or slightly depressed.

c. Size small.

Tritogonia tuberculata, 0.085 by 0.100 mm. (fig. 31).

1a. Ventral margin obliquely rounded.

aaa. Hinge line long.

d. Size large.

Quadrula heros, 0.260 by 0.340 mm. (fig. 32).

2. Glochidium semicircular.
   a. Hinge line long and nearly straight.
      b. Size medium.
         Quadrula ebena, 0.160 by 0.150 mm. (fig. 33).
         Quadrula plicata, 0.200 by 0.200 mm. (fig. 34).
         Quadrula solida, 0.160 by 0.160 mm. (fig. 35).
         Quadrula trigona, 0.160 by 0.155 mm. (fig. 36).
         Truncilla sulcata, 0.200 by 0.205 mm. (fig. 37).
         Unio gibbosus, 0.200 by 0.215 mm. (fig. 38).
   aa. Hinge line shorter, with gradual curve.
         Obliquaria reflexa, 0.225 by 0.235 mm. (fig. 39).
3. Glochidium semicircular.
   a. Ventral margin obliquely rounded.
      b. Hinge line long, straight or slightly curved.
         c. Size medium.
            Cyprogenia irrorata, 0.210 by 0.185 mm. (fig. 11).
            Pleurobema æsopus, 0.220 by 0.200 mm. (fig. 12).
4. Glochidium kidney-shaped.
   a. Hinge line long and straight, or nearly so.
      b. Size medium.
         Dromus dromus, 0.190 by 0.100 mm. (fig. 13).

ILLUSTRATIONS.

PLATE I.

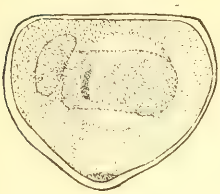
1. Alasmidonta calceola.
2. Anodonta imbecillis.
3. Strophitus edentulus.
4. Anodonta corpulenta.
5. Arcidens confragosus.
6. Symphynota complanata.
7. Symphynota costata.
8. Lampsilis alata.
9. Lampsilis capax.
10. Lampsilis lævissima.
11. Cyprogenia irrorata.
12. Pleurobema æsopus.
13. Dromus dromus.

PLATE II.

14. Plagiola securis.
15. Lampsilis luteola.
16. Lampsilis subrostrata.
17. Lampsilis recta.
18. Lampsilis ligamentina.
19. Quadrula granifera.
20. Quadrula pustulosa.
21. Lampsilis anodontoides.
22. Lampsilis fallaciosa.
23. Lampsilis higginsi.
24. Lampsilis ventricosa.
25. Obovaria ellipsis.
26. Quadrula metanevra.
27. Quadrula pustulata.
28. Lampsilis gracilis.
29. Plagiola donaciformis.
30. Plagiola elegans.
31. Tritogonia tuberculata.
32. Quadrula heros.
33. Quadrula ebena.
34. Quadrula plicata.
35. Quadrula solida.
36. Quadrula trigona.
37. Truncilla sulcata.
38. Unio gibbosus.

PLATE III.

39. Obliquaria reflexa.
40. Lampsilis trabalis.
41. Encysted young of Plagiola donaciformis, showing great growth of adult shell beyond the margin of the glochidial shell.
42. Alasmidonta truncata.
43. Anodontoides ferusaccianus subcylindraceus.
44. Symphynota compressa.
45. Anodonta grandis.
46. Lampsilis iris.
47. Obovaria retusa.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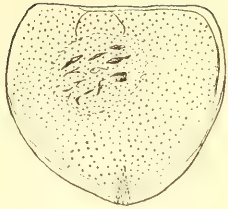
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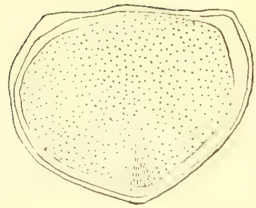
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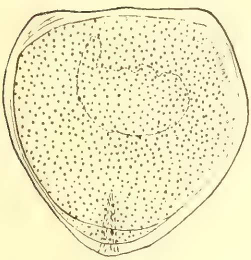
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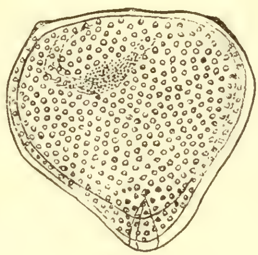
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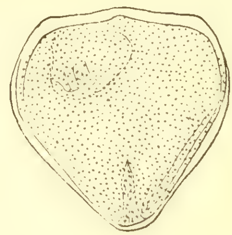
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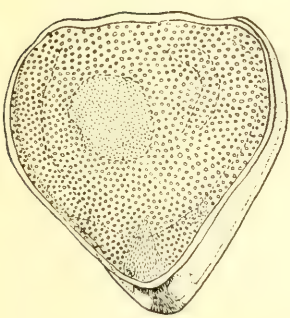
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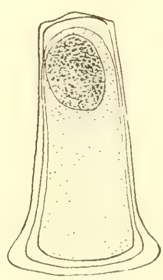
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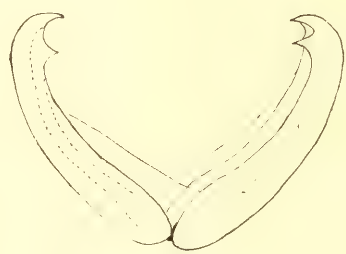
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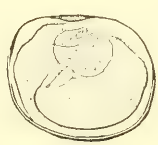
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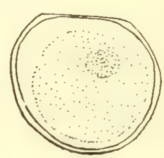
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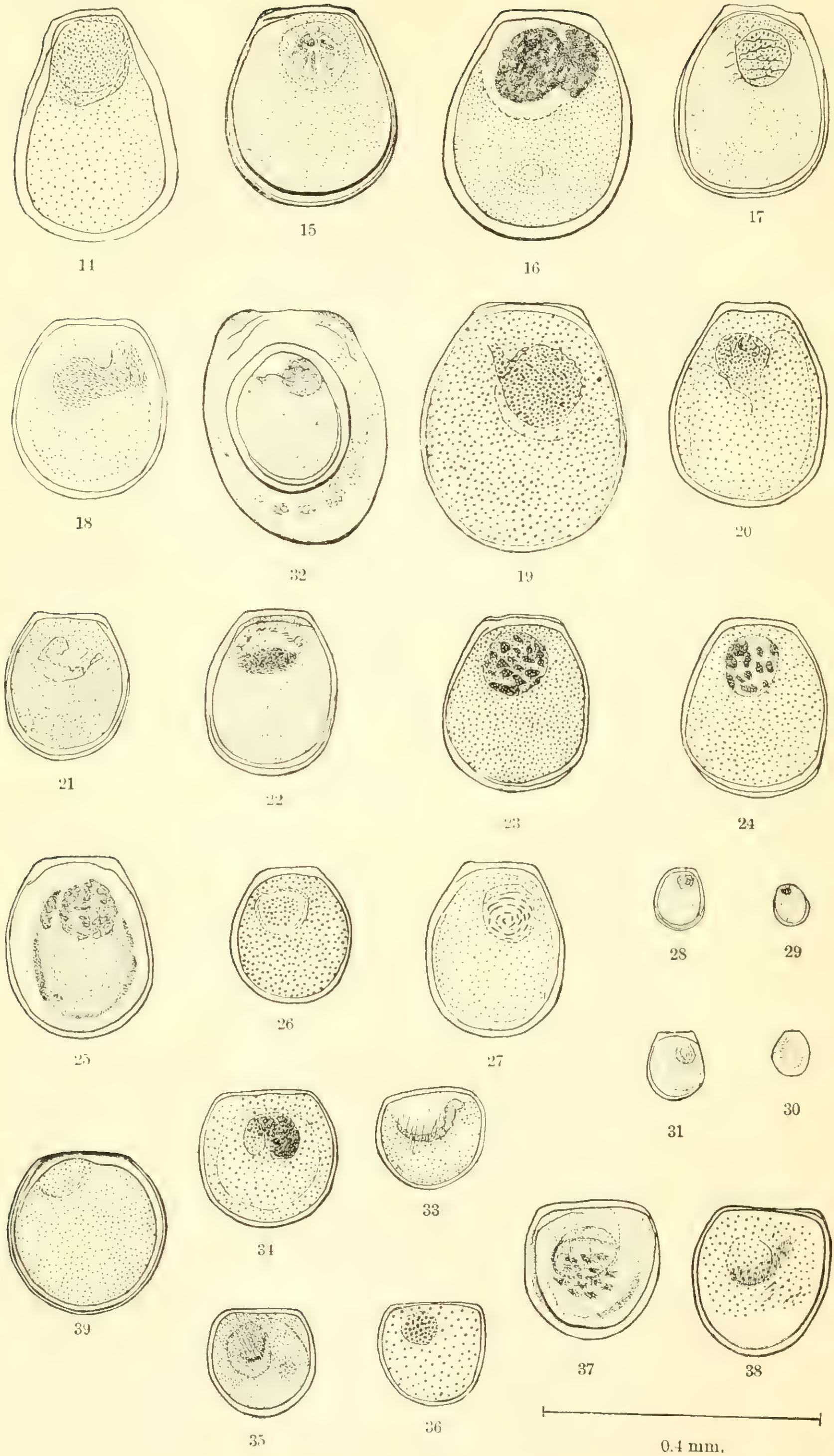
PLATE II.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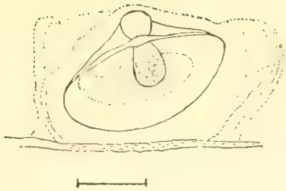

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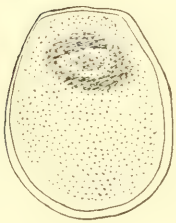

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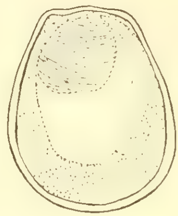

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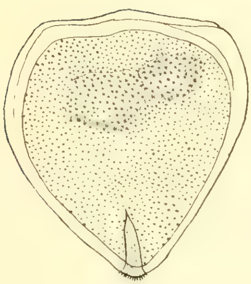

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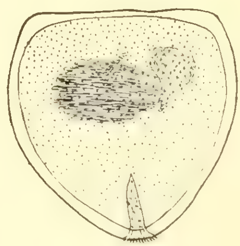

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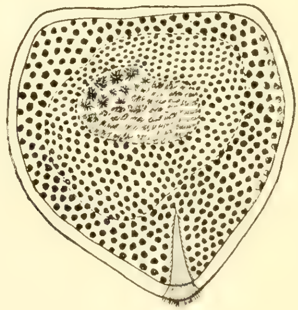

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FISHERY AND FUR INDUSTRIES OF ALASKA IN 1912

BARTON WARREN EVERMANN
Chief of Alaska Fisheries Service

Bureau of Fisheries Document No. 780

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FISHERY AND FUR INDUSTRIES OF ALASKA IN 1912.

GENERAL ADMINISTRATIVE REPORT.

By Barton Warren Evermann, *Chief, Alaska Fisheries Service.*

The Alaska Fisheries Service, originally covering only the salmon fisheries, then extended to all Alaska fisheries, including the fur seal, now covers all the other fur-bearing animals of Alaska also, this new responsibility being added by the act of April 21, 1910, and definitely provided for in the appropriation bill of March 4, 1911.

Until 1911 the annual reports of the fur-seal service and the fisheries were published as separate documents, but in that year they were combined and issued as one. The same method is continued in the present report, which includes also a special report of the fur wardens on the mainland.

SALMON FISHERIES.

INSPECTION.

The inspection of the salmon and other fisheries of Alaska was carried on during the season of 1912 in accordance with detailed instructions from the Washington office. On account of the limited appropriation it was possible to send to the field only three of the four regular employees of the Alaska salmon service and even these had to be restricted in their movements in order to keep expenses within the allotment which could be made for their travel and subsistence. As much of the territory as possible, however, was covered. The agent, Mr. Fred M. Chamberlain, was stationed during the season in the Bristol Bay region, where he was assisted by Messrs. G. Dallas Hanna, deputy fur warden, E. A. Beard, of the Yes Bay Station, and C. B. Grater, of the Afognak Station. Attention was given primarily to the inspection and supervision of the commercial fishing operations and the canneries in the Nushagak region and to a study and census of the run of salmon in Wood River, in continuance of the investigations begun in 1908 when Wood River was closed by Department order to all commercial fishing. Lack of transportation facilities made it impracticable to visit all the fisheries and canneries in the Bristol Bay region, hence only those easily reached from Nushagak were inspected.

Inspection of the fisheries about Chignik Bay, Alitak, and Karluk had to be omitted, the inspector in this region being busily engaged during the season superintending the fishing operations of the natives of the Afognak reservation, who, under authority of the Department, were permitted to fish for commercial purposes in the waters of the reservation. Assistant Salmon Agent Ward T. Bower spent the season in southeast Alaska visiting as many of the fisheries, canneries, and salteries as possible, and all the salmon hatcheries. He was able to make one trip to Yakutat and Prince William Sound.

It is regretted that it was not possible to visit the Yukon region or Arctic Alaska, in which it is learned from incomplete data that fisheries of importance are developing.

COMPLAINTS AND PROSECUTIONS.

One of the functions of the Alaska Fisheries Service is the enforcement of the law and regulations. In the exercise of this duty, notwithstanding the lack of adequate facilities and means to cover the field thoroughly, several prosecutions were instituted during 1912.

On Sunday, July 28, 1912, when the assistant salmon agent was on an inspection trip accompanied by the district attorney, a trap of the Alaska Packers Association located on the west shore of Gravina Island was found to be fishing contrary to the provisions of the weekly closing law. At the special October term of the district court held at Ketchikan, the grand jury returned a joint indictment against the Alaska Packers Association, a corporation, owner of the trap, and W. E. Ludy, the watchman having the trap in charge at the time named in the indictment. Action in the case was continued until the spring term of court.

On Sunday, August 4, 1912, one of the Bureau's deputies discovered a floating trap of the Alaska Pacific Fisheries, located near the entrance to Yes Bay, to be fishing. The watchman, A. Carlson, was arrested and given a preliminary hearing before the United States commissioner at Ketchikan. He was released, the evidence then adduced not being deemed sufficient to warrant binding over to the grand jury. However, at the October term of the district court at Ketchikan, the grand jury investigated the matter, and a true bill was returned against the Alaska Pacific Fisheries, a corporation, owner of the trap, and against A. Carlson, watchman. The case has not yet come to trial.

In November, 1911, M. Kono and 20 other Japanese were arrested for fishing for herring on Sunday in the waters of Yes Bay. They were released upon cash bail in the sum of $1,000. During May, 1912, the grand jury at Ketchikan returned a true bill against these 21 defendants. At the same term of court at which the indictment

was returned counsel for the Government moved the court to forfeit bail of defendants for nonappearance for arraignment and trial. The motion was granted. Counsel for the defense thereupon moved the court to set aside the order for forfeiture of bail, for the reason that the crime charged was a misdemeanor rather than a felony, thus not requiring presence of defendants, and that counsel were authorized and ready at all times to appear for the defendants at arraignment and trial. Counsel for the United States contended that the offense was a felony, thus requiring the presence of defendants at all stages of the trial, including arraignment, and their failure to appear personally for arraignment must result in forfeiture of bail.

Judge Lyons, before whom arguments were made, held that personal presence in a misdemeanor charge is not required until after judgment is pronounced. The court stated that if a defendant is then not personally present to render himself in execution of judgment, whatever it may be, his bail may be forfeited; but during the trial he may appear by counsel and not suffer forfeiture. The serious issue at hand then became whether the indictment charged a misdemeanor or a felony. Judge Lyons held that a violation of the Alaska fisheries law is a misdemeanor, and for this reason, on November 13, 1912, directed that the order of forfeiture previously entered be set aside. The case was continued until the following spring term of court.

PRIBILOF ISLANDS.

PERSONNEL IN CHARGE.

The administration of the fur-seal service in 1912 followed the same general plan as in 1911 with respect to the management of the seal herd.

During the winter of 1911–12, Assistant Agent James Judge was in charge on St. Paul Island. He arrived on the *Homer* June 16, 1911, and remained until September 9, 1912, when he left on the *Homer* for San Francisco and Washington. Mr. M. C. Marsh, naturalist for the islands, who reached St. Paul August 23, 1911, on the second trip of the *Homer*, remained on the island until September 9, 1912. Besides these, the Government was represented on St. Paul Island during the winter of 1911–12, by Dr. E. J. McGovern, resident physician, Assistant Agent A. H. Proctor, and the school-teacher, Mr. P. R. E. Hatton. During the same period the Government was represented on St. George Island by Assistant Agent E. W. Clark, in charge, Mr. Ned B. Campbell, school-teacher, Dr. H. C. Mills, resident physician, and Mr. Leonard Tongue, storekeeper. In addition to these, the Government was represented during the summer of 1912

by the chief agent, Mr. Walter I. Lembkey, and Mr. George A. Clark, special investigator.

At the end of the season of 1912 the personnel in each island was as follows:

St. Paul Island, Chief Agent W. I. Lembkey, in charge; Dr. E. J. McGovern; storekeeper, Mr. Leonard Tongue; Mr. Alvin G. Whitney and Mrs. Elsie G. Whitney, school-teachers.

St. George Island, Assistant Agent A. H. Proctor, in charge; Dr. H. C. Mills; and Mr. P. R. E. Hatton, school-teacher.

In the summer of 1912 the supply steamer *Homer* made two trips to the islands. On the first, she left San Francisco May 27, arrived at the islands June 12, left the islands June 28, and arrived at San Francisco July 12. On the second trip she left San Francisco August 4, arrived at the islands August 24, left the islands September 12, and arrived at San Francisco September 27. The unusual time required on the second trip was due to unfavorable weather which could have been avoided if the trip could have been made earlier in the season.

A detailed report upon the administration of the islands, by Chief Agent Lembkey, appears on pages 74 to 98.

SALE OF FUR-SEAL SKINS.

After renewed consideration it was decided to continue, for the present at least, the practice of selling the fur-seal and fox skins at auction in London. The sealskins taken in the sealing year ended August 10, 1912, 3,764 in number, plus 9 skins taken in the previous season and sent to Washington for experimental purposes, were therefore sold at auction by C. M. Lampson & Co., in London, January 17, 1913, bringing a return of $140,431, or an average of a little more than $37 apiece. The net proceeds to the United States Government, after payment of brokerage, marine insurance, and miscellaneous expenses of the sale were $130,640.57.

BLUE FOXES.

Formerly, when the number of seals killed each year was sufficient to furnish an abundance of food for the foxes on St. George and St. Paul Islands, a large number of foxes could be taken annually. In the 19 years from 1842 to 1860, the number taken each year varied from 1,125 to 2,658, and averaged 1,850. During the 40 years from 1870 to 1910, the average annual catch was over 1,000 skins. During recent years when the number of fur seals killed was limited, with the result that the amount of refuse seal meat available for the foxes was not enough to meet their needs, the fox herd became greatly reduced in numbers and only a few hundred could be killed each year. In 1912 food was so scarce that the foxes were forced to prey upon each other.

Until a larger number of seals can be killed, this deplorable condition will probably continue. It may be improved by purchasing and supplying to the foxes other kinds of food; the legality of this, however, has been questioned. Under the present law no seal meat suitable for human food can be fed to the foxes. Only the refuse parts of the carcasses can be used for that purpose.

In the past year the foxing season on St. George Island began November 23 and continued until February 7.

The method of taking foxes on this island is by means of a large wire box trap, about 14 by 10 feet. A door controlled from within admits the animals, which as caught are brought to the agent, who examines each one, liberates the most fit ones for breeders, after marking, and passes the others to the killers. The most vigorous young foxes, of superior pelage and color, are selected as breeders. The food used in the trap to attract the animals consists of salted seal meat. The trapping is done at night.

The number of foxes taken in 1912 was 170 blue males, 105 blue females, and 2 white males.

The fox herd on St. Paul Island has always been much smaller than that on St. George. The original reason for this was probably the greater abundance of natural food obtainable by the foxes from the populous bird rookeries of St. George. With an abundance of food supplied there would seem to be no environmental reason why St. Paul Island should not support at least as many foxes as St. George.

On St. Paul Island the foxes are caught in steel traps, as so far it has been found impossible to induce them to enter box traps. During the trapping season in the winter of 1911–12, there were taken 109 blue and 27 white foxes on this island. The entire catch for the two islands was therefore 384 blues and 29 whites, or a total of 413 pelts.

These were sold at auction in London by C. M. Lampson & Co. on March 7, 1913, for $21,708.48 for the blues and $501.43 for the whites, or $22,209.91 for all. It is of interest to note that the average of $57 for the blue fox skins far exceeded the average price of the sealskins ($37) for that year, and the maximum price for blues was as high as $131 per skin, received for a lot of 31. The net proceeds of the entire sale of fox skins were $20,505.17.

INTRODUCTION OF REINDEER.

One of the most notable and economically important achievements in connection with the fur-seal service was the establishing of a herd of reindeer on each of the Pribilof Islands. This was accomplished through the cooperation of the Department of the Interior, which, through its Bureau of Education, supplied the animals necessary for

stocking the islands. At the end of August, 1911, the U. S. Revenue Cutter *Bear* took on board at Unalakleet, Alaska, 40 head of reindeer, 25 of which (21 cows and 4 bulls) were placed on St. Paul Island August 31, and the remaining 15 (12 cows and 3 bulls) were landed on St. George Island the next day, September 1. All were adult animals except two of the males placed on St. George, which were yearlings. The adult bull put on St. George soon disappeared and has not been seen since. In landing those intended for St. Paul Island a leg of one of the bulls was broken and the animal died a few days later. In the winter one of the young cows wandered away from the herd and died. The remaining 23 animals on St. Paul (20 cows and 3 bulls) and 14 on St. George (12 cows and 2 young bulls) passed through the winter successfully and practically all of them in the spring appeared to be in excellent condition.

Between April 17 and May 21, 1912, inclusive, 18 fawns were born on St. Paul, and during approximately the same period 11 were born on St. George. One of the former was stillborn. Of the latter there were 9 males and 2 females. The sexes of those on St. Paul were not determined.

At the end of August, 1912, the Pribilof herds contained a total of 65 reindeer, all fat and sleek and apparently in excellent condition.

Two native Eskimo herders, one for each island, had been brought from the mainland. They gave the herds such attention as was necessary. The animals were permitted to roam at will over the islands except for a brief period during which the cows were retained in corrals while the fawns were being dropped. During the early part of the fall the herds remained chiefly on the lower parts of the islands, where they fed on the grasses which grow there luxuriantly. As colder weather and snows came on, the animals moved to higher ground, where they fed chiefly on reindeer moss.

In the opinion of the herders, the naturalist, and the agents, there is an abundance of reindeer moss and suitable grasses.

It was found, contrary to some predictions, that the reindeer did not interfere in the least with the fur seals. They rarely went near the rookeries, and when they did no disturbance resulted.

It is believed that the success of this experiment justifies the belief that a herd of several hundred reindeer can be maintained on each island. In all probability the herds can be built up and maintained at a number which will permit the killing of at least 200 head annually. Not only will the reindeer be thus useful in supplying a considerable amount of very desirable food for the inhabitants of the islands, but they will also prove of great value on the islands for use in transportation.

The beaches of the islands are often strewn with large quantities of driftwood which, except in the immediate vicinity of the villages from

which it is sometimes gathered up by the natives, remains to rot. By the use of sledges and reindeer teams this can all be collected and hauled to the villages, when its use would greatly reduce the amount of coal needed for the islands.

MINOR FUR-BEARING ANIMALS.

FIELD FORCE.

The force available for administration of the laws and regulations affecting the fur-bearing animals of Alaska other than the fur seals consisted of the warden, Mr. Harry J. Christoffers; four deputy wardens, Messrs. Fred H. Gray, Lee R. Dice, G. Dallas Hanna, and Claude J. Roach; and, by reciprocal arrangement with the government of Alaska, five special wardens detailed from the Territorial game department for supplementary service. Messrs. Christoffers, Dice, and Roach were sent to the interior of Alaska; Mr. Gray was assigned to southeast Alaska with headquarters at Wrangell; and Mr. Hanna was sent to the Bristol Bay region.

OBSERVANCE OF LAW AND REGULATIONS.

The wardens report that, as a rule, the fur law and regulations were fairly well observed in most respects. In some localities the trappers were disposed to begin trapping before the open season had begun. In the spring, particularly in the muskrat and white-fox regions, trapping and hunting would be continued after the end of the close season. There was little or no excuse for anticipating the open season; all the investigations made indicate that the dates fixed as the beginning of the open season for the respective species are as early as the condition of the fur justifies. This, however, can not be said regarding the spring dates for muskrats and white foxes.

It was found, upon investigation and inquiry, that it is very difficult to get muskrats until after the ice has gone out; and as this does not take place until in May it may be seen that if the open season were to end April 30, as provided in the regulations, the hunters would get practically no muskrats unless they violated the regulation. The result was that the Indians, who are the only hunters seeking the muskrat to any extent, were quite prone to ignore this regulation. It was found by the wardens that the fur of the muskrat remains prime until in June. In view of these facts it has been thought proper to extend the open season for muskrats to June 1, which has been done.

As to the white fox, it was found that in the northern part of Alaska the fur remains prime quite late in the spring and the severe storms in the middle of winter make it impossible for the natives to do much trapping until in February and March. In view of these

facts the open season for foxes in the region drained by streams leading to the Arctic Ocean has been extended to April 1.

In the interior the Indians are reported as killing a few beaver, primarily for food. The skins are used by the Indians themselves as trimming for their garments. As a result of the visits of the wardens to the beaver regions and the warnings given, the Indians are now believed to be observing the regulation more fully.

Many complaints have come to the wardens and to the Bureau regarding the use of poison for killing fur-bearing animals, chiefly foxes. The wardens were instructed to investigate carefully any such reports or rumors, and a number were investigated. In nearly every case the report was found to be without any discoverable basis of fact, and not in a single instance was it possible to justify reporting the case. That poison is used is quite certain. The offenders are invariably white men and the worst are probably those that operate on the Alaska peninsulas and adjacent islands.

In at least one instance a conviction could no doubt have been secured if the available appropriation had permitted an expense of about $100 to send a warden to the locality to secure the evidence. Lack of funds has handicapped the service in many cases of this kind.

The wardens were active in pursuing offenders of all kinds, in spite of the limit that had to be placed on their field expenses, and several cases were reported to the United States marshals, resulting in at least three convictions. One of these was at Andreafski, one at Chicken, and one at Kokwok. These are the first convictions ever obtained in Alaska for violation of the fur law.

IMPROVEMENT IN QUALITY OF FURS SHIPPED.

Although the fur-animal regulations have now been in force less than three years, prominent fur dealers in Seattle, San Francisco, Chicago, and New York state that there has been a marked improvement in the quality of furs received from Alaska since the fur-bearing animals of that Territory were placed under the Department of Commerce. Some of the dealers say that the furs now received from Alaska are as much as 30 per cent better in quality than formerly.

They attribute the improvement to the elimination of unprime skins. Formerly a good many summer or out-of-season skins were received. Nearly every shipment contained some skins that were not prime—skins that had been taken either too early in the fall or too late in the spring, or even in the summer. It is evident that the trappers are beginning to realize that there is more money in a prime than in an unprime skin; that the animal whose fur is poor in October will be in good condition a few weeks later and that it pays

to let the animal alone until its pelt has become prime. By exercising a little self-restraint and deferring for a few weeks the capture of the animal the money return will be five to eight times as great.

Now that the shipment of unprime skins is prohibited, a still greater improvement in the quality of furs handled may be confidently predicted.

PERMITS TO TAKE FUR-BEARING ANIMALS FOR BREEDING OR OTHER PURPOSES.

Within the last few years great interest in fur farming has developed in certain sections of America, particularly in Prince Edward Island, New Brunswick, and other parts of Canada. Within the last year or two the interest has spread to Alaska. The result has been that the Bureau has received many requests for permits to capture various fur-bearing animals, chiefly foxes, in Alaska and use them there or elsewhere for breeding purposes. Several requests were also received for permission to collect fur-bearing animals in Alaska for museum purposes, for zoological parks, or for other purposes. Up to November 30, 1912, 19 permits had been issued.

SHIPMENT OF FURS FROM ALASKA.

The method adopted in 1910 for the purpose of securing the Alaska fur statistics has proved fairly satisfactory; it is probably as good as can be devised unless the personnel of the fur-animal service should be greatly increased. The method is as follows: On appropriate blanks provided by the Bureau for the purpose, any person shipping furs by express or freight will make a report to the Bureau, giving, for each shipment, (1) place and date of shipment, (2) name and address of consignee, (3) number and value of pelts of each kind shipped, and (4) signature of shipper. Any person shipping by mail must fill out a similar blank giving the same data, which blank, after having been signed by the shipper and certified by the postmaster, will be mailed to the Bureau of Fisheries by the postmaster.

The open season during which furs may be legally taken extends, roughly, from October to June; for most of the species it extends from November 15 to April 1. The furs taken in any particular open season are nearly all shipped early in the spring following, and all will be shipped before the following fall. Therefore, the shipments made between November 15 of one year and November 16 of the next will include practically all the pelts taken in the open season between those dates. For this reason the Bureau has fixed upon November 16 to November 15 following, both inclusive, as the fur year, for statistical purposes.

In the year ending November 15, 1912, fur shipments were made from 120 different places in Alaska. Among the most important

shipping points are St. Michael, Nome, Fairbanks, Wrangell, Juneau, Seward, Nushagak, and Ketchikan.

The following statement in tabular form shows by species the amount and value of furs shipped from Alaska in the year ending November 15, 1912:

SHIPMENT OF FURS FROM ALASKA IN 1912.

Species.	Number of pelts.	Average value per pelt.	Total value.
Bear, black	698	$7.50	$5,212.50
Bear, brown	19	9.00	171.00
Bear, glacier	5	15.00	75.00
Bear, polar	9	40.00	360.00
Beaver	89	10.00	890.00
Ermine	7,957	1.36	10,821.52
Fox, black	3	600.00	1,800.00
Fox, blue	502	45.00	22,590.00
Fox, blue, Pribilof Islands	384	56.53	21,708.48
Fox, cross	603	17.00	10,251.00
Fox, red	8,018	8.50	68,153.00
Fox, silver gray	142	250.00	35,500.00
Fox, white	3,108	12.50	38,850.00
Fox, white, Pribilof Islands	29	17.29	501.43
Hare, arctic	55	.40	22.00
Lynx	2,720	21.50	58,480.00
Marten	12,999	12.50	162,487.50
Muskrat	123,925	.40	49,570.00
Mink	31,363	4.50	141,133.50
Otter, land	1,480	14.00	20,720.00
Otter, sea	1	200.00	200.00
Reindeer fawn	4	1.00	4.00
Seal, fur	3,764	37.52	141,290.32
Seal, hair	333	1.50	499.50
Squirrel	611	.08	48.88
Wolf	103	9.00	927.00
Wolverine	189	10.00	1,890.00
Total			794,156.63

RECOMMENDATIONS.

Among the recommendations and suggestions which have been submitted by the warden and deputy wardens are the following:

1. Extend the open season for muskrat to June 1.

2. Shorten the open season for marten two weeks by making it end March 15 instead of March 31.

3. Extend the open season for the white fox to April 1.

4. Make it unlawful to purchase, offer to purchase, sell, offer to sell, export, or have in possession any unprime skin.

5. Extend the close period for beaver five years, thus making it unlawful to take any beaver before November 1, 1920.

6. Encourage the establishment of fur farms, especially on the coast, where fish for food are abundant.

7. Establish an experimental station at some suitable point in Alaska where investigations and experiments in the domestication and propagation of fur-bearing animals may be carried on.

8. Make stricter regulations regarding the sale of poisons.

9. Make a special study of the distribution, abundance, and habits of the beaver.

10. Offer a bounty for the destruction of wolves.

Several of these recommendations have already been acted upon favorably, those regarding the close seasons for the muskrat, marten, white fox, and beaver, and that relating to unprime skins being now embodied in the revised regulations issued March 26, 1913. That recommending a bounty on wolves has also been approved, and it is hoped Congress may enact such a law. The other recommendations are proper ones, and the Bureau has already taken steps toward their realization.

In addition to the foregoing recommendations, it is vitally important that the law of April 21, 1910, be amended so as to give more power to the Secretary of Commerce. Section 4 of that act, when strictly interpreted, gives the Secretary power only to prevent the killing of fur-bearing animals. It has been questioned whether he has any power to prevent the pursuit, capture, or possession of fur animals at any time, or any authority over the shipment of the animals alive. The law should be amended so as to cover all these points.

The Bureau's force of five wardens is entirely inadequate to secure a proper observance of the regulations in all parts of that great territory. The number should be increased so that a deputy warden could be stationed during the shipping season at each of the most important shipping points and so that one may remain during the trapping season in each of the important fur regions.

FISHERY INDUSTRIES.

By Fred. M. Chamberlain, *Agent*,
and
Ward T. Bower, *Assistant Agent*.

As in similar reports for previous years, the Territory of Alaska is here considered in the four geographic sections generally recognized, as follows: Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, Kodiak region, Chignik, and all of the Aleutian chain of islands; western Alaska, the shores of Bering Sea, tributary waters and the islands in Bering Sea; and arctic Alaska, all that portion of Alaska facing on or tributary to the Arctic Ocean.

In the following pages are given not only detailed reports and statistical tables dealing with each of the various fishery industries, but there are presented also reports on certain subjects which were the objects of special investigations or inquiries made by the agent or assistant agents.

AFOGNAK RESERVATION.

Under the regulations published March 21, 1912, permitting a limited amount of commercial fishing in the reserved waters of the Afognak Island reservation, 93 licenses were issued, 7 of these to white men. This gave opportunity to the inhabitants to secure employment for their labor and lawfully to make use of a natural resource which might otherwise have been partly lost. About 160,000 fish of all species were taken besides those used at the hatchery.

The insufficiency of the resources of the Bureau has hitherto prevented an adequate patrol of this reservation. Persons not disposed to obey the law have taken salmon from the unguarded streams more or less continuously since the reservation was established. From the best information procurable it appears that the salting of salmon bellies for commercial purposes began about eight years ago and increased from year to year, until in 1911 approximately 60,000 red salmon were thus used. In addition to this number other fish were used for domestic purposes. The total extent of this poaching is unknown, and it was rendered uncertain whether any good results could

have been obtained by entirely stopping the capture of fish in these streams. There is reason to believe that entire prohibition of fishing in certain localities while in the adjacent regions fishing is carried on with little or no restriction, will be much less effective as a preservative measure than a limited fishery in all localities. In any event an unenforced regulation which permits the lawless to gain at the expense of the law-abiding is worse than useless.

On Afognak Island are five streams that carry an appreciable run of redfish. To regulate the fishery which resulted from the order opening this reservation, an agent was detailed to patrol the section, issue licenses, and establish proper restrictions to adjust the fishing to the main purpose of reasonable conservation. The kind and size of gear to be used was specified, markers designating the 100-yard limit were set at the stream mouths, and in addition to the weekly closed seasons prescribed by law a midweek close season of 36 hours was provided for Malena stream, and the entire closing of Letnik Bay was maintained.

The largest stream and lake on the island is Letnik, but of the five streams carrying redfish Malena stream carries the best and most regular run. This stream is about 5 miles in length and 25 feet wide. It drains two small lakes each about 2 miles in length, the lower about one-half mile and the upper about 1 mile in breadth. The principal spawning ground is in the main tributary of the upper lake. The stream empties upon an open beach, and being without protection the fishery is often interrupted by rough weather. This may have had an influence in preserving the run of salmon here at a time when fishing was most vigorous in past years. The fish are recognized as larger than those of any other Afognak stream.

Paramanof stream flows into a small bay on the west side of the island. It is similar in size and character to Malena but of only about half the length. It drains a small lake about one-third mile wide by 1 mile long. The spawning grounds are in two streams, each about 10 feet in width, entering this lake. From the subjoined table it will be seen that a much smaller percentage of humpbacks were taken in this stream than in Malena or Seal Bay.

Seal Bay on the north side of the island receives the stream second in size of the island streams. This stream is about 75 feet in width and 1½ miles long. It drains two lakes, expansions of the main stream, each about the size of the upper lake of Malena stream. Each lake has a number of small tributaries available for spawning ground, but the principal ground is apparently the connecting stream between the two lakes. It will be noted that a much larger proportion of humpbacks were taken in this stream than at the others. Perhaps the main outlet section of the stream offers an important ground for this species.

Little Afognak stream ranks fifth as a fishing stream. It drains the largest lake of any except Letnik. The outlet stream is about 2 miles in length. This stream has been barricaded and, whether from this cause or natural unproductiveness, the red salmon run is apparently far below what it should be.

The run of red salmon began about the first of June, but only at Paramanof stream reached numbers enough to exceed the home consumption. At this stream 2,500 were salted by June 6, when the eruption of Katmai Volcano suspended all fishing in that region. The ashes fell for three days, covering Afognak Island from 3 to 10 inches in depth, the heavier fall being on the south side of the island. The waters of hitherto clear streams and lakes were converted into mud. The streams were for the time choked and deposits several feet in depth formed at their mouths. The salmon in the streams were either driven back to the deep water or perished in the streams. Fortunately the run had only begun, and only in the Letnik stream was there any considerable loss. It was noted that the fish in the bays retreated to deep water, and it was some time before their return was assured.

After the third day, when the shower of ashes had so far ceased as to make travel safe, the fishermen abandoned their work and returned home; those at the most distant station, Seal Bay, were brought back by a revenue cutter. It was not without much persuasion that they were induced to resume work, about July 1, a rumor having been circulated that Congress had made a large appropriation for their relief.

The number of fish reaching the lakes during the recess in the fishing and at other times is not positively known, but so far as observations go almost no successful spawning was accomplished in any of the streams. Few fish were seen on any of the beds. As late as the middle of August salmon were suffocated in the tributary streams by the volcanic mud washed in by rains. At times salmon could be seen to enter a stream, ascend a short distance, and then return to the sea. Many of the spawning grounds were choked by the deposits. The young, so far as known, were not killed in the lakes. In some instances fish examined in August appeared to be inadequately nourished, but in other cases they were thrifty.

Later the ash was largely washed from the streams, and there should be no great obstruction to successful spawning of the 1913 run. It will be of much interest and value to note the effect of the volcanic phenomena upon the runs of 1916 and 1917.

The following table shows the catch reported from the various streams with the date of the fishing:

Catch of Salmon in the Afognak Reservation, Season of 1912.

Streams and species.	Date.	Number.
Malena:	1912.	
Red	July 2–Aug. 18	42,690
Humpback	do	23,791
Silver	July 5–Aug. 18	31
Dog	July 2–Aug. 9	134
King	July 2–Aug. 18	144
Total		66,790
Paramanof:		
Red	June 1–Aug. 26	20,265
Humpback	July 2–Aug. 20	4,950
Silver	Aug. 3–26	267
Dog	July 9–24	38
King	July 2 and 6	2
Total		25,522
Seal Bay:		
Red	June 28–Aug. 26	12,629
Humpback	July 15–Aug. 21	17,781
Seal Bay—Continued.	1912.	
Silver	July 22–Sept. 8	6,274
King	July 5	1
Total		36,685
Little Afognak:		
Red	July 29 [a]–Aug. 9	7,017
Humpback	July 31 and Aug. 1	438
Silver	Aug. 11–Sept. 14	1,953
Total		9,408
Grand total:		
Red		82,601
Humpback		46,960
Silver		8,525
Dog		172
King		147
Total		138,405

[a] The first day's fishing took 1,595, showing the run was not just beginning.

This table does not show the complete figures for the silver salmon, as, after the dates given, they were in some cases prepared for home use and not reported. Thus the Malena run of silvers ranks third in size. It is estimated that about 20,000 fish were used by the inhabitants for food, 17,000 handled at the hatchery, making a total of about 175,000 salmon of all species from the waters of Afognak Island.

The reds and silvers were sold by the fishermen for 3½ to 4 cents each; the pinks for 2½ cents. The total catch is estimated to have yielded to the licensees about $4,396.

WOOD RIVER INVESTIGATION.

The census of salmon entering Lake Aleknagik was made in 1912 as in the previous four seasons. The number of redfish entering the lake was 325,264, as against 354,000 in 1911. The winter of 1911–12 was exceptionally mild and the spring of 1912 early. At the time of arrival of the cannery vessel, May 17, the bay and beaches were entirely clear of ice, whereas in 1911 the last of the ice did not leave until late in June.

It would seem, under these circumstances, that the run should have begun and should have reached its maximum much earlier in 1912 than in 1911. Anticipating this possibility, the rack was got in place early in June. The first fish appeared at the rack June 22, when 50 were passed through. In 1911 the first fish were noted July 4, when 228 were passed through the gates. Since the beginning of these investigations in 1908 the runs have shown each season at the rack two more or less distinct maxima. The first and less distinct maximum in 1908 occurred July 11; in 1909, July 6; in 1910,

July 10; in 1911, about July 10, but merging closely into the later; and in 1912, July 3. The second and highest maximum in 1908 was reached July 14; in 1909, July 14; in 1910, July 15; in 1911, July 15; and in 1912, July 8, but in this case it was much less distinct, the curve showing a secondary rise July 16 and 17. On the whole, it may be said that the run in 1912 was about a week earlier than in the four years just preceding.

As no temperature data are at hand, the relation of the run to temperature can not be determined. It may be assumed that in the absence of the ice fields the higher temperatures would have been reached much earlier; that is, as much earlier as the time of disappearance of the ice was earlier, but a consideration of the probable amount of influence of the ice and the cold water of the streams upon the lower waters of the bay or those of the sea in which the fish are feeding readily leads to the conclusion that the acceleration of the run was quite equivalent to the effect produced by the absence of ice.

The tally at the Lake Aleknagik rack was as follows:

SALMON ENTERING LAKE ALEKNAGIK, SUMMER OF 1912.

Date.	Number.	Date.	Number.	Date.	Number.	Date.	Number.
1912.		1912.		1912.		1912.	
June 22	50	July 3	19,056	July 14	1,148	July 25	417
23	58	4	4,834	15	26,090	26	742
24	24	5	14,888	16	34,803	27	901
25	11	6	3,125	17	34,835	28	312
26	7	7	11,237	18	8,568	29	165
27	45	8	44,054	19	8,558	30	438
28	48	9	22,019	20	7,054	31	39
29	277	10	11,110	21	5,470		
30	280	11	21,035	22	2,355	Total	325,264
July 1	1,333	12	22,146	23	725		
2	3,859	13	13,057	24	91		

The relation of the catch to the escapement into Wood River is shown in a table below. In considering these figures it must be kept in mind that an unascertained number of redfish ascend the Nushagak River to spawning beds. It is known that this number is small as compared with the number ascending Wood River. This fact is well recognized by the packers and was further substantiated in 1911 by the operation of two gill nets in the Nushagak River throughout the season. While the census at Lake Aleknagik thus does not show the escape for the entire bay, nevertheless the figures for that factor of the total escape show the relative escape year by year.

RED SALMON RUN IN NUSHAGAK BAY AND TRIBUTARIES, 1908–1912.

Years.	Nushagak Bay catch.	Wood River tally.	Total.	Per cent of escape.
1908	6,140,031	2,600,655	8,740,686	30
1909	4,687,635	893,244	5,580,879	16
1910	4,384,755	670,104	5,054,859	13.2
1911	2,813,637	354,299	3,167,936	11.1
1912	3,866,950	325,264	4,192,214	7.7

Salmon in the Commercial Catch, Bristol Bay Region, 1904 to 1912.

[Compiled from the reports made by the packers.]

Species and stream.	1904	1905	1906	1907	1908
Red salmon:					
Nushagak	5,227,659	6,574,335	5,237,512	2,522,024	6,140,031
Egushik	118,000	200,000	190,000	105,327	292,000
Kvichak-Naknek	5,856,442	6,773,275	4,954,905	6,782,072	9,306,641
Egigak	136,759	140,000	238,000	481,578	781,131
Ugushik	564,492	432,779	203,014	302,402	272,355
Miscellaneous			135,000	66,500	166,870
Total	11,903,352	14,120,389	10,958,431	10,259,903	16,959,028
King salmon:					
Nushagak	85,787	87,789	105,058	104,157	69,125
Egushik		500			50
Kvichak-Naknek	11,406	17,470	28,774	28,495	20,162
Egigak			400	1,410	1,213
Ugushik	760	2,456	4,162	3,615	2,056
Miscellaneous			1,530	1,725	600
Total	97,953	108,215	139,924	139,402	93,206
Coho salmon:					
Nushagak	123,661	58,148	207,257	135,699	103,013
Egushik					
Kvichak-Naknek	5,250	7,000			
Egigak					
Ugushik	558	5,733			
Miscellaneous				3,150	
Total	129,469	70,881	207,257	138,849	103,013
Pink and dog salmon:					
Nushagak	374,709	206,488	1,715,126	752,886	808,166
Egushik					
Kvichak-Naknek	36,731	37,146	343,563	45,458	7,594
Egigak	2,691	49,000	14,000	20,925	29,197
Ugushik	21,323	45,767	82,797	26,972	14,199
Miscellaneous				1,500	
Total	435,454	338,401	2,155,486	847,741	859,156
Grand total	12,566,228	14,637,886	13,461,098	11,385,895	18,014,403

Species and stream.	1909	1910	1911	1912	Total.
Red salmon:					
Nushagak	4,687,635	4,384,755	2,813,637	3,866,950	41,454,538
Egushik	219,000	85,000	143,436	126,478	1,479,241
Kvichak-Naknek	9,533,337	6,336,382	4,587,344	13,821,905	67,952,303
Egigak	840,674	619,001	1,158,176	1,455,247	5,850,566
Ugushik	218,237	168,471	112,521	425,763	2,700,034
Miscellaneous	143,000		129,600	201,943	842,913
Total	15,641,883	11,593,609	8,944,714	19,898,286	120,279,595
King salmon:					
Nushagak	108,311	86,433	103,806	87,384	837,850
Egushik				105	655
Kvichak-Naknek	17,084	13,629	7,951	9,570	154,541
Egigak	2,891	801	460	202	7,377
Ugushik	2,203	892	1,046	467	17,657
Miscellaneous	1,500			940	6,295
Total	131,989	101,755	113,263	98,668	1,024,375
Coho salmon:					
Nushagak	80,513	139,200	129,971	195,083	1,172,545
Egushik					
Kvichak-Naknek				10	12,260
Egigak					
Ugushik					6,291
Miscellaneous				11,029	14,179
Total	80,513	139,200	129,971	206,122	1,205,275
Pink and dog salmon:					
Nushagak	450,740	636,589	325,559	1,855,795	7,126,058
Egushik				303	303
Kvichak-Naknek	1,900	313,170	101,688	156,685	1,043,935
Egigak	16,049	5,432	3,416	7,319	148,029
Ugushik	10,728	7,156	8,967	14,167	232,076
Miscellaneous	1,015			2,448	4,963
Total	480,432	962,347	439,630	2,036,717	8,555,364
Grand total	16,334,817	12,796,911	9,627,578	22,239,793	131,064,609

Examination of the above tables reveals a continuous and, since 1908, steady decline in the percentage of escape, thereby testifying to the effectiveness of the present-day fishing methods. In 1908 nearly a third of the fish known to have entered Nushagak Bay reached the spawning grounds of Wood River in spite of the fact that nearly a third of the total catch for Bristol Bay was made in Nushagak waters. In 1911 under a similar ratio of catch in Bristol Bay only 11 per cent of the Nushagak fish escaped the nets, and in 1912 when less than a fifth of the Bristol Bay catch was made in Nushagak waters less than 8 per cent reached the lake.

The 1912 red salmon run in Bristol Bay was peculiar in that, although there was a remarkably heavy run on the south side, from Ugushik to the Kvichak, the number entering Nushagak Bay was somewhat fewer than in 1910. In 1908, as between the Nushagak and the Naknek-Kvichak regions, about 40 per cent of the catch was made in the former section, whereas in 1912 only about 22 per cent of the catch was made there. This is the more remarkable as the prevailing winds, southerly and southeasterly, were supposedly favorable. Dr. C. H. Gilbert, who in 1903 conducted investigations in the Bristol Bay region, makes the following comments relative to the shifting of runs in this region:

On all the streams good years and poor years alternate, and have always done so. Furthermore, although the mouths of these streams are in such close proximity, they may differ widely in abundance of fish during any one year. The present year showed a very heavy run on the Kvichak, a rather poor run on the Nushagak, and very light runs on the Ugushik, Igigik, and Naknek. In 1902 the case was very similar, but in 1901 and 1900 there were very heavy runs on the Nushagak and very light runs at Koggiung. The fact that the principal streams, the Kvichak and the Nushagak, do not have heavy runs the same year suggests the theory that all the Bristol Bay streams draw from a single school of salmon which may chance to run most heavily in one or the other river in any given year. I have heard it stated that the smaller streams, Ugushik, Igigik, and Naknek, have good seasons when the Nushagak has, and poor seasons when the Kvichak is full of fish. The Kvichak enters the extreme head of Bristol Bay. If a single school supplies all these streams it may be that during some seasons the greater part of the run may proceed directly to the head of the bay and up the Kvichak, while in other seasons the run may turn principally into the side streams (analogous shiftings occur yearly in each stream). An alternative theory would be that each stream had its separate supply determined in advance, the run consisting of fish which had been spawned in that stream. In order that we may deal effectively with the salmon problem in Bering Sea it is important that these alternative theories be thoroughly tested. No facts are now at hand bearing upon them, but the question could probably be settled by tagging adult fish at the beginning of the run and setting them free well away from the mouths of the rivers.

Nothing is known concerning the life of the adult salmon in the sea, nor do we know the direction from which they approach Bristol Bay. They appear suddenly off the mouths of the rivers. During some seasons they appear in quantity first in the Nushagak, in other seasons they run heavily in the Kvichak a few days before they run in the other streams. It is frequently, if not universally, noted that the stream having the heaviest run in any year has also the earliest run. We are ignorant of

the factors which determine the variations in run from year to year. It can hardly be a question of temperature, or of height and quality of water, for all the streams are subject to essentially the same climatic conditions and would vary together from year to year.

In 1908 the run seems to have gone to the south side of the bay, rather than to have passed the side streams to enter that at the head of the bay; all of the streams of the peninsula from the Ugushik up had good runs.

The large run of 1912 is undoubtedly the result in large measure of the heavy run of 1908. Scale examination shows both 4 and 5 year fish, the former probably preponderating in the schools captured off the Kvichak-Naknek regions. As yet the study of the scales is too incomplete to make positive statements. It would seem, however, that a considerable number of the 1908 spawning should be expected to return in 1913. Perhaps not sufficient regard has been given to the seasonal effect upon the reproductive output of salmon. We are accustomed to rate the effective result in adults as directly proportional to the number of spawning fish reaching the beds. That this leaves many factors unaccounted for is evident at once. Unknown conditions vary the output. It is well understood that in certain seasons herring reproduce much more effectively than in other seasons; the increased number of individuals originating in a particular year showing throughout several succeeding years as a higher proportionate number in the total school. This augmentation is probably due to physical factors and such factors must in the same way influence the output of salmon.

In addition to these uncontrollable natural factors, large numbers of spawners on the limited spawning beds of the salmon must result in a different ratio of fry to eggs deposited as contrasted with results from a smaller number of spawners. That is, if 2,600,000 spawners reached Lake Aleknagik in 1908, and only 325,000 in 1912, it does not follow that the returns of the 1912 spawning will be less than one-eighth of that of 1908. But even if it be true that there is a point of maximum effectiveness beyond which the relative output decreases, it must also be true that, aside from the influence of physical factors not under control, the greater the number of spawners reaching the lake the greater the total number of young produced; so that while the 325,000 spawners of 1912 will produce a greater relative output, i. e., more adult fish per thousand spawners, the total number of adults derived from this spawning will be far fewer than the number derived from the 2,600,000 spawners of 1908.

The researches of Dr. Gilbert on the Fraser River sockeyes have demonstrated that an almost negligible number of the adult sockeyes are from young which went to sea as fry, i. e., without one winter in fresh water. Observations in Wood River and elsewhere tend to

prove that few young leave the streams as fry when the number of spawners is small, whereas in heavy runs as in 1908 many do. This may be one of nature's checks. And because of these various factors it may well be that the supply of fish can be maintained by permitting only a portion of the adults to reach the spawning grounds and reproduce. Furthermore, since not all salmon mature at the same age, and since exceptional years cause exceptional results from the eggs deposited, it should not be anticipated that the fishery will suddenly fail, nor that it will decrease gradually, but that it will fluctuate with good and bad years for a considerable period.

It can not be doubted that the heavy run of 1912 was in part, if not largely, due to the large escape of 1908. The five-year return from that will help out the catch of 1913. The reports for 1909 indicate a small run on the south side of the bay, but the catch was greater in that section than in 1908. This suggests a small escape, and in the natural order of events the number of four-year fish taken in 1913 should be small. If no unusually favorable conditions for reproduction obtained in 1909 there should be a good run in 1913, due to the number of five-year fish returning, and after that date there should be a marked decrease in the runs until 1916.

The movement of yearling salmon was given somewhat less attention than in 1911. But one lot of 108 Lake Aleknagik fingerlings, taken July 12, was preserved. These averaged only 92.3 mm. in total length, or 8 per cent less than those of 1912. On the other hand, a lot of 21 sockeyes, taken at Lewis Point on the Nushagak July 28, averaged 66 mm. These examples, while still showing a marked difference in size between the migrating fingerlings of the two streams, somewhat reduce the disparity observed last season; but the principal fact, i. e., that there is thus a well-defined difference in size, is further exemplified by these later collections.

About the middle of June a number of small fingerling sockeyes, fish of the spring hatch from 1911 spawn, were noted in Wood River just below the lake. It is believed these small fish are the product of eggs deposited in the lower portions of Lake Aleknagik at points from which the fry would be carried down by the current. They were seen for only a few days, June 11 to 14.

STREAMS CLOSED TO COMMERCIAL FISHING.

On October 18, 1912, a hearing was held in Seattle, Wash., to consider the closing of certain streams in Alaska under the authority conferred upon the Secretary of Commerce and Labor by the law of 1906. After hearing all parties desiring to express their views, and ascertaining that the consensus of opinion favored the closing proposed, the following order was issued:

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, November 18, 1912.

To whom it may concern:

A hearing having been given at Seattle, Washington, October 18, 1912, after due notice by publication and otherwise as provided by law, for the purpose of determining the advisability of making salmon breeding reserves of certain streams together with their catchment basins, and all interested persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An Act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all commercial fishing for salmon, or other commercial fishing in the prosecution of which salmon are taken or injured, be and is hereby prohibited in waters of Alaska, as follows:

1. In all streams flowing into Cook Inlet, together with their lakes and tributary waters.
2. In Eyak Lake and its tributary waters. Fishing will be permitted in Eyak River below Eyak Lake and in its branch, known as Mountain Slough, from 6 a. m. Monday to 6 p. m. Saturday of each week, but only with rod, spear, or gaff, and with drift nets and seines not anchored or otherwise fixed within said waters.
3. In Anan or Humpback Creek, its lagoon, lakes, and tributary waters, together with the region within 500 yards of the mouth of said creek.
4. In Naha stream, its lagoon, lakes, and tributary waters, above a line connecting he points known respectively as Loring Point and House Point.

This order becomes effective January 1, 1913.

CHARLES NAGEL, *Secretary.*

There are now closed to commercial fishing, by authority of the Secretary of Commerce or by Executive order of the President, six streams or regions, namely: (1) In western Alaska, Wood and Nushagak Rivers; (2) in central Alaska, all streams flowing into Cook Inlet, all streams on Afognak Island, and Eyak Lake, including a limitation on fishing in Eyak River; (3) in southeast Alaska, Anan stream, Yes Bay and stream, and Naha stream.

Complete and efficient measures for the protection of salmon must include not only the limitation of fishing to the degree essential to preserve a sufficient number of spawners from among the mature fish, but in addition the maintenance of the waters and spawning beds of the fish, or a substitution of hatcheries for the latter. The proper volume, low temperature, and purity of the streams are factors essential to attract the run of adults and to maintain the health of the young; freedom from obstruction is necessary to permit ascent of spawners; and either undisturbed spawning beds or properly equipped hatching houses are required to develop the eggs. Without these requisites mere preservation of the parent fish can not maintain the supply; it is just as essential that proper conditions for deposit and development of the eggs and the growth of the young shall obtain as that adults shall be spared to furnish eggs.

The preservation and increase of the area of natural spawning ground has heretofore received little attention. The industries that are likely to involve damage to these grounds have not developed in

number and extent as yet to bring about such results. The natural grounds remain in almost their original character and area, hence the absence of care or forethought in respect to them. These matters seldom receive attention until appreciable damage has been inflicted. Furthermore, it is, perhaps, generally supposed that artificial hatching may prove an adequate substitute for any damage done the natural beds when the time arrives to make provision. As pointed out above, there are other considerations. In the case of the more valuable salmon it seems that to get healthy spawn it is requisite that the fish mature in fresh water, of appropriate temperature, volume, and purity; without this a hatchery could not be operated.

While no actual figures are available, there appears to be no reason to doubt that crowding the spawning beds necessarily results in loss of spawn. It follows then that an increase of suitable ground would work to the advantage of the fishery. There are quite a number of streams in Alaska in which falls prevent the entrance of salmon. In some of these a fishway could be provided at comparatively small expense that would admit spawning fish to considerable areas of suitable beds. Along the same line, perhaps, assistance could be rendered by facilitating the ascent of such falls as are now passable only at certain stages of water. The actual value of such improvements can be ascertained only by trial and observation. The continuance of the fishery in spite of the heavy drains made upon it goes far to prove that the supply may be maintained by permitting a fraction only of the adults to reach the beds. From this it may be reasoned that the possible product is controlled by the area of suitable spawning ground rather than by number of spawning fish, given, of course, a sufficient number of spawners to seed the ground. If this argument is valid, measures to extend and improve the grounds will add proportionately to the output.

Hatcheries, while now beyond question merely as to whether they are effective in furtherance of the maintenance of the fishery, are not always considered from their purely economic value. The real question is not, Will hatcheries, given the parent fish, perpetuate the supply?—for that is answered on the Sacramento River—but, Will they do it at least cost? As at present conducted, the whole value of the hatcheries lies in the greater percentage of fry they produce from a given number of eggs. This value can probably be expanded to cover at least a portion of the life of the young after hatching, or, to be more exact, after yolk absorption, for no hatchery worthy of consideration now plants yolk fry. The real question then is: Is the cost of operation of the hatchery exceeded by the value of the fish saved to commercial consumption?

For example, assume in a given stream a run of 100,000 fish. Assume, to maintain that run, 50,000,000 fry must reach the free-

swimming stage. A hatchery can produce those 50,000,000 young fish from 50,000 adults; therefore the other 50,000 adults may be put into cans and no diminution of the subsequent supply result. The difference, then, between this 50,000 fish required by the hatchery and the number required to spawn on the natural beds to maintain the supply represents the value of the hatchery. Assume that the number required to spawn naturally is 75,000; then the hatchery has saved 25,000 fish, which at 20 cents each are worth $5,000. This is the real value of the hatchery's work.

It must not be lost sight of that the margin of raw material rendered available by the hatchery may be of much greater comparative value than the original margin of equal number above the requirements for natural propagation. For example, in the case cited, the first 25,000 fish, the available excess above natural spawning requirements, may just fail to meet the cost of conversion into a commercial product, in which case no commercial use could be made of them at all. Whereas, by the added 25,000 available under the hatchery system, the additional cost of operation may be met and a substantial profit made. Again, it must be remembered that with experience more certainty may be introduced into the business under a controlled and known system of propagation, and anything which tends to remove the speculative element tends to reduce cost of operation. These figures are merely hypothetical, and without statistics not now available real values can not be estimated. The only purpose of the computation is to illustrate the fallacy of regarding the operation of hatcheries as the sole or even as the necessarily best means of maintaining the salmon fishery.

As a commercial proposition it might be better to curtail the pack and permit a large spawning escape than to make the maximum pack and exhaust even a portion of the increased gross receipts in maintenance of the supply of raw material.

MARKED SALMON.

An unusual number of "marked" salmon were taken during the season at the Fortmann and Yes Bay hatcheries. At Yes Bay the superintendent reports taking 28 females and 13 males with both ventrals missing, and 6 females and 4 males with one ventral gone. He adds that he believes had the examination of the males in the course of spawning been as thorough as of the females, there would have been as many males as females noted. About a dozen of these marked fish were reported from the Fortmann hatchery at Loring up to the end of October. An examination of the scales of these fish shows them to be of the ordinary type. Examples from three individuals were examined, a female from Loring and a male and a female from Yes Bay. All appear to be 4-year fish. There is always a

shade of doubt regarding the scale rings of spawning fish, but in no case can these fish be adjudged to be more than 5 years old, and they are in all probability only 4 years old. In the case of two examples of complete loss of ventrals, a rough dissection indicated that the pelvic arch had been wholly lost. This tends to prove that the removal of the fins occurred at a very early age. In an example with one fin partially removed, leaving only a stub, there had been no atrophy of the arch.

The suggestion that these fish are of the lot marked in 1903 is absurd. Aside from the inherent improbability of a second group appearing in this way at such a distant interval from the first return in 1906, the record of the scales is final evidence of the real age of the fish. To account for the presence of the fish, there seem to be but two possible hypotheses. First, that the disappearance of the fins is due to some natural cause and their loss is either congenital or arises from some action of an external agent, such as fungus, upon the fry; or second, that the fish were marked by human agency.

As against the first proposition is the fact that in all of the examples seen, no fins other than the ventrals are damaged. It is well known that fungus attacks the unpaired fins more often than the paired. The return of about 50 adults would imply that the cause was directed toward some 3,000 fry. The hypothesis that nature suddenly and irregularly produced this many monstrosities is untenable on its face. Hence, we must fall back on the new factors introduced by artificial propagation. The diseases of fry are not sufficiently well known to suggest any affection that would show in the adult in no other respect than in an absence of these fins. Any disorder of the ventral region involving these parts would almost necessarily involve adjacent structures. The only reasonable conclusion seems to be that some cause carried away the external fin structure in such early life that the bony arch never developed; that is, atrophied from a lack of use. For example, it is inconceivable that fungus attacking the fish while in the yolk stage and resting on the bottom could destroy these fins and yet reach no other structure. The only possible proposition that can serve as a basis for argument against this conclusion is that the fungus may have likewise damaged the adjacent fins, as the anal, but that these later regenerated while the ventrals did not. Since these "marked" fish were noted only at the hatcheries at Loring and Yes Bay they probably originated in that section.

Experiments in excising the fins indicate that if the rays are not entirely removed the fin will regenerate, at least partially. It has, as yet, not been determined that the fin will assume its original size, but from the growth observed there is no reason to doubt that it will. The entire removal of any fin or its rays to the base—that is,

to the spines or carpal bones on which the rays rest—will be permanent, and the fin will not grow again.

Some experiments were made at the Yes Bay hatchery this season to arrive at a definite method of marking fingerlings and it is believed that the results point to a practicable system, but further tests are required to perfect it. Observations of the "marked" fish noted above demonstrate the necessity of a marking which can not be duplicated by unauthorized experimenters and which will authenticate the returned fish beyond all question.

HATCHERIES.

EXTENT OF OPERATIONS.

During the year 1912 seven salmon hatcheries operated in Alaska as heretofore. The Karluk plant is the only hatchery at which the take of eggs was up to the limit of capacity. The takes, however, are not always true indications of the runs at the various streams. At the Karluk station the parent fish are seined from the lagoon which receives Karluk River. These fish are of the number which have escaped the cannery seines at the spit and are on their way to their spawning grounds about Karluk Lake. This escape is always greatly in excess of the needs at the hatchery. Such a number of them as it is believed will be required to furnish sufficient spawn to fill the hatchery are intercepted and held in corrals till ripe. The number of eggs taken at this place therefore depends neither on the total run of fish nor on the escape, but upon the judgment of the hatchery superintendent, qualified by the loss of fish in the corrals.

At the Yes Lake station also the number of eggs taken is only indirectly related to the size of the run. Commercial fishing is carried on in the bay or immediately adjacent waters under the supervision of the hatchery superintendent. When in his judgment the run exceeds the number that are required for hatchery purposes, then commercial fishing is allowed; if the run seems insufficient, then commercial fishing is interdicted until the superintendent believes enough fish have entered the lake to supply the quantity of spawn needed to fill the hatchery.

As the number of fish entering the lake can be estimated only by the apparent abundance in the bay and stream, it will sometimes happen, as in the past season, that not enough fish reach the lake to fill the hatchery; but such a shortage does not necessarily imply a small run.

On the other hand, the hatcheries at Afognak, Loring (Fortmann), Klawak, Hetta, and, usually, Quadra have of late years made use of all the fish available for their purposes and yet failed to fill their troughs. From this statement must be excepted the single season

of 1911 at Loring when not all the available fish were spawned for the hatchery. The number of eggs taken at the various stations in the years 1911 and 1912, as well as the number of fry liberated from the 1911 eggs, is shown in the following table:

OPERATIONS OF ALASKA HATCHERIES IN 1912.

Stations.	Red or sockeye salmon eggs taken in 1911.	Red or sockeye salmon fry liberated 1911-12.	Per cent of loss.	Red or sockeye salmon eggs taken in 1912.
Yes Lake	72,000,000	68,335,000	5	66,125,000
Afognak [a]	30,520,000	18,394,700	39.7	14,689,470
Fortmann	107,520,000	100,335,000	6.6	23,160,000
Karluk	41,026,800	37,495,100	8.6	45,600,000
Klawak	5,600,000	3,530,000	37	3,835,000
Hetta	2,585,000	2,342,000	9.4	3,700,000
Quadra	11,000,000	10,166,000	7.5	10,000,000
Total	270,251,800	240,597,800	....	167,109,470

[a] Some humpback and coho eggs also handled; 3,271,740 humpback eggs were taken in 1912. At both the Yes Lake and Afognak hatcheries the numbers under "fry" include the fingerlings held and fed in the troughs.

The take of eggs at the Afognak station in 1912 was greatly reduced by the loss of fish incident to the volcanic eruption. All of the salmon lying below the rack at the time of the fall of the ashes from Katmai Volcano, June 6 to 9, were killed; this involved a loss of some 8,000 or 10,000 sockeye salmon.

An interesting situation is shown at the Klawak hatchery. This plant has a capacity of 8,000,000 to 10,000,000 eggs. The catch of fish for the cannery has increased. During the years preceding 1901 the average annual catch was under 40,000, while in the last four years it has been almost 50,000, and in the last two considerably over that number. The hatchery, until 1910, was small and did not make use of all the spawning fish entering the lake. The number of eggs taken was comparatively small, and heavy losses at times from freezing largely neutralized any advantage derived from the operation of the hatchery. In 1910 the capacity was increased to 10,000,000, but fewer than 7,000,000 eggs were taken, presumably from lack of spawners. In 1911 there was a larger catch of fish for the cannery and a still smaller take of eggs for the hatchery, fewer than 6,000,000. In 1912, while the returns for the catch are not definite, they indicate a still larger number of fish taken for the canneries, and the egg take dropped to fewer than 4,000,000.

Hetta shows a still more remarkable situation. At this point, from 1896 to 1900, an annual average of nearly 200,000 redfish were taken. By 1909 this had dropped to fewer than 55,000. In that year slightly over 10,000,000 redfish eggs were taken, about 10 per cent of the fish escaping to the lake. In 1910 the catch increased a few thousands and the egg take fell off a million. In 1911 the catch was

very little in excess of 50,000, and the egg take was fewer than 3,000,000; in 1912 the catch was again slightly increased and the egg take increased proportionately to nearly 4,000,000, showing a spawning escape of about 4 per cent. This high degree of efficiency of the seiners is brought about by the conformation of the bay. It will probably be impossible for them to take all the fish without barricading the stream, but their present effectiveness will prove a sufficiently close approximation to exterminate the run commercially in a few more years.

HATCHERIES AS A CONSERVATION PROVISION.

Perhaps the best example of results to be obtained from hatcheries is to be found in the Fortmann hatchery at Loring, on the Naha stream. At this station, since its establishment in 1901, the entire run of redfish has been devoted to propagation uses. In 1903 the hatching plant was extended to its present size and, with the exception of one season, 1911, the entire number of redfish entering the upper lake has been artificially spawned, so the number of eggs taken each year indicates with fair accuracy the number of fish entering the stream. These figures are shown in the following table:

REDFISH EGGS TAKEN AND FRY LIBERATED, 1901 TO 1912.

Years.	Eggs taken.	Fry liberated.[a]	Years.	Eggs taken.	Fry liberated.[a]
1901	11,460,000	....	1907	41,280,000	80,946,000
1902	40,050,000	10,300,000	1908	24,465,000	33,920,000
1903	16,536,000	29,005,000	1909	53,340,000	22,785,000
1904	63,120,000	13,780,000	1910	34,920,000	40,725,000
1905	68,715,000	62,160,000	1911	107,520,000	30,245,000
1906	105,420,000	67,643,000	1912	23,160,000	100,335,000

[a] Product in each case of eggs taken the previous year.

The factor of error introduced by these figures as an exponent of the number of fish entering the stream lies in the fact that an uncertain number of fish spawn each year below the upper lake. In 1911 these were numerous and not counted; in 1912 a considerable portion of the eggs secured were taken in the lower lake, thus entering the count. But in general, the number of fish may be arrived at approximately by omitting the last three places in the figure for eggs. For example, in 1912, 23,160 fish may be credited to the stream. From 1887 to 1891 this stream yielded to the canneries an annual average catch of 78,000 fish; in the next five years it dropped to half of that, or 39,000; in the next four years to less than half of this, or 15,000. Under hatchery operations on a closed stream, the run the first four years averaged annually about 33,000; in the next four years it reached 60,000, but in the last four years it has fallen again to an average of 54,000. In the initial period of four years, of course, only the natural run was produced; that is, the product of the hatchery

had no influence on the number of adult fish in the stream. The first two seasons not all the fish were spawned and the average, 33,000, is too small. It is not improbable that 40,000 would be more nearly correct. This would indicate either that the fishing during the years 1897 to 1900 was light or that an unusual number of fish from other streams entered the Naha for spawning.

Weighing all the evidence, it seems most reasonable to conclude that in the main the average run reaching a given stream is the product of that stream; that normally the fish return to the place of their birth, but that, due to adventitious causes, schools at times are diverted and enter other streams. In this way both the permanent depletion of given streams, as at Hetta, and also the extraordinary runs, as in the Naha in 1906 and 1911, may be accounted for. There is no evidence that sockeyes once entering a lake to spawn return to salt water. If there were no inherent tendency to return to the home stream the distribution would be more irregular, the streams near the ocean would be filled to overflowing, or else, on the contrary, the congestion would occur at the head of the passages. If this instinct were absolutely controlling there would be no such fluctuations as are noted in Bristol Bay. Now, the remarkable fact to be noted is that in the Naha with a closed stream the increase in the run for the first four-year period is not greatly over 50 per cent, and in the second like period it has actually fallen off. In other words, after 12 years of protection and artificial propagation, a season occurs in which no more fish enter the streams than did the first year the stream was closed. This does not prove the hatching operation a detriment, for no better results were attained on Letnik stream, which was closed for many years without a hatchery.

Yes Bay in 1912, as nearly as can be estimated, produced about 100,000 redfish; in 1911 about 150,000; in 1910 about 200,000; in 1909 about 150,000; and in 1908 fewer than 100,000. There is little doubt that the run in this stream and that in the Naha are closely related, perhaps interchanging more or less. Considering the two streams together, the sum of the runs for each year from 1908 to 1912, inclusive, is, respectively, 120,000, 210,000, 235,000, 260,000, and 125,000. The catch at these two streams at the period of their original productiveness indicates that they should produce in the neighborhood of 100,000 each, so that from 1909 to 1911 we may adduce that their natural resources were quite fully restored by the restricted fishing and the hatching operations.

To go beyond the natural product brings in new factors. No doubt the primary factor is food. The sockeye, like the other red-meated salmon, is known to divide as to the habit of the young; one portion remains in fresh water for a year, the other goes to salt water soon after reaching the swimming stage. As shown by Dr. Gilbert (p. 9), out of 625 Fraser River fish examined only 35, or about

5 per cent, were sea run, i. e., had gone to sea as fry. Either the loss during the growth to maturity is very much greater in that portion of the young seeking the sea the first season or that portion is very much smaller than the portion remaining a year in fresh water. In 1903 and 1904, when a comparatively small number of fry was being put out by the hatchery on the Naha, it was found that few went to sea as fry. It was suggested then that upon greatly increasing the number planted in that stream a certain surplus might go to sea as fry and thereby be largely lost. Unfortunately, as yet no examination has been made to find whether such a result occurs. If there is such a result from the large plants the failure of the Naha as yet to build up beyond its natural productivity may be accounted for.

A further suggestion was made, as a result of the studies of 1903 and 1904 on the Naha, that the food resources of the lake might be overtaxed by the heavy plants of fry and the young become unthrifty. Measurement of some 80 yearlings of the 1911 fish from this stream revealed the astonishing fact that they were in better condition and larger than fish of corresponding age measured in 1903 and 1904. The stomachs of most of these were empty, but in two were found salmon fry. Nearly all the intestines contained a black substance that is believed to be mainly the indigestible substances derived from fry ingested some time previously, the digestible elements having been absorbed. This evidence of cannibalism suggests another possible check upon results from the increased plants. Fry planted as soon as hatched, or even as soon as free swimming, arrive in the lake when it is still populated with the yearlings of the previous season's plant. The old rule that big fish eat little ones finds no exception among salmon, and overpopulation of the waters must be an active stimulus to this natural instinct.

It has been shown that the salmon return at 4 and 5 years of age, perhaps in about equal numbers, probably varying in different seasons. Taking Yes Bay and Naha streams together as a unit, there were liberated in the two hatcheries in 1906, i. e., from 1905 spawn, 74,000,000 fry. The adults from these fry were due to return in 1909 and 1910. To the two streams there may be accredited for those two years 445,000 fish, and half of these should be credited to the 74,000,000 fry of the 1905 eggs. Constructing a table on these bases for the three years now completed and estimating the fourth, we have:

Year.	Fry.	Adult fish.	Average.	Year.	Fry.	Adult fish.	Average.
1905	74,000,000	225,000	328	1907	95,000,000	192,000	495
1906	135,000,000	247,000	550	1908	71,000,000	143,000	500

That is, the run for 1913 should be 134,000 for the two streams.

From this calculation we arrive at an approximate figure of 500 hatchery-produced fry to bring back one adult redfish.

At no other streams have the hatching operations been complete for a sufficient time to permit estimates. At Hetta the fish scatter about the lake margins and many have spawned naturally until the last two years, when scarcity of spawners has led to a more industrious effort to take all the fish. A similar condition obtained to a degree at Klawak and Quadra. Even at the Fortmann and Yes Lake hatcheries a certain percentage escape or spawn naturally during high water, and, as mentioned above, there is always a considerable number of fish which spawn naturally at the former of these stations, but it must be swamped as a factor of influence in the very large artificial output.

Heretofore it has been the custom when sockeyes were not available to fill the hatcheries to supplement the take with cohos and even humpbacks. To hatch the latter can at least do no damage to the sockeye output, since this species leaves the fresh water as fry. With the cohos it is otherwise. The coho fingerling is an active enemy of smaller fish. Many of them linger in fresh water for the first year after hatching, leaving usually on the spring floods, when the sockeye fingerlings migrate. They bear the same relation to small salmon that trout of similar size do. Their propagation in the same fresh water with sockeyes is not to be commended. Dr. Gilbert has found that the adult cohos are derived almost wholly from young migrating as yearlings, hence any output of the hatchery to be of value must remain in the lakes and streams where it will prey upon the sockeye young for the greater part of a year. Coho young are larger at hatching and grow more rapidly, hence there might be more or less cannibalism among those of the same age after a few months. No cohos are now hatched at the Fortmann hatchery, nor allowed to spawn naturally in the upper lake. It is the belief of the superintendent who was in charge of the Callbreath experiment for several years, that the propagation of cohos at the Jadski hatchery helped to defeat the success of that station. The maintenance of this latter station at Jadski stream for some 15 years by Mr. Callbreath at his personal expense is one of the most interesting incidents in the history of the Alaska salmon fishery.

Firmly imbued with the belief that every salmon returns to the stream or lake of its birth to spawn, and convinced of the advantages of protected propagation, Mr. Callbreath foresaw large profits from the cultivation of fish in private or privileged reserves. Unfaltering in his conviction as to the correctness of these two fundamental propositions, he expended a small fortune in the prosecution of the enterprise and even then surrendered only to age and infirmity. The

only result has been a further demonstration of the illogicalness of founding a commercial enterprise upon suppositious conclusions. Perhaps one-tenth the amount lost in this speculation, properly applied to an inquiry into the natural history of salmon, would have demonstrated the fallacy of the methods employed, if not even of the propositions themselves. The only fact developed is that humpback salmon do not necessarily return to the parent stream. This stream has been consistently fenced to the humpbacks since the initiation of the experiment in 1892, but the number reaching the stream in late years has shown no diminution beyond that of other streams in the same region. The irregular fishing for red salmon carried on in the inlet to which the hatchery stream is tributary deprives the figures as to the hatch of all value.

GENERAL STATISTICS OF ALASKA FISHERIES FOR 1912.

Of the $38,263,457 invested in all Alaska fisheries in 1912, nearly 90 per cent represents the salmon industry. Excluding the cod and halibut fisheries, in order to secure a proper basis for comparison with the previous year, it is found that there was an increase of $13,281,346 over 1911, the result of the phenomenal prices brought by the cheaper grades of the pack of that season.

Summary of Investments in the Fisheries of Alaska in 1912.

Industries.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Salmon canning	$13,267,304	$7,462,261	$13,029,730	$33,759,295
Salmon pickling	54,760	133,195	199,610	387,565
Salmon mild curing	314,072	11,215	875	326,152
Herring fishery	336,860	2,030	....	338,890
Halibut fishery	2,027,250	8,800	....	2,036,050
Cod fishery	....	274,674	....	274,674
Whale fishery	....	....	....	1,140,831
Total	....	....	....	38,263,457

Summary of Persons Engaged in the Fisheries of Alaska in 1912.

Races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Whites	4,548	1,912	3,641	10,101
Natives	3,058	679	3,562	7,299
Japanese	1,477	464	1,400	3,341
Chinese	1,242	533	1,211	2,986
Miscellaneous	47	14	475	536
Total	10,372	3,602	10,289	24,263

SUMMARY OF PRODUCTS OF THE ALASKA FISHERIES IN 1912, SHOWING QUANTITIES AND VALUES.

Products.	Quantity.	Value.	Products.	Quantity.	Value.
Canned salmon....cases..	4,056,021	$16,295,490	Frozen salmon..pounds..	451,043	$20,287
Halibut.........pounds..	16,896,743	927,502	Fresh halibut, local.do....	250,000	18,000
Mild-cured salmon..do....	4,195,843	399,852	Fish pudding......cases..	1,925	11,550
Whale products:			Smoked salmon loaf.do....	2,157	8,628
Oil.............galls..	928,755	311,307	Fresh cod.......pounds..	100,000	8,000
Fertilizer....pounds..	3,285		Smoked fish loaf...cases..	1,135	4,540
Baleen..........do....	22,522		Trout...........pounds..	26,461	2,645
Pickled salmon..barrels..	34,750	307,422	Eulachon..........do....	40,365	2,315
Herring.........pounds..	15,444,523	239,278	Black cod..........do....	16,654	953
Cod...............do....	8,064,843	218,268			
Fresh salmon.......do....	1,338,923	101,463	Total..............	....	18,877,480

SALMON INDUSTRY.

The season of 1912 was marked by an unusually heavy run on the south side of Bristol Bay. This was the principal factor in the increase of nearly 40 per cent in the total catch for the Territory over last season. The other important elements were an unexampled run of humpbacks in central Alaska and a large run in Bering Sea, and the utilization of an increased number of chums mainly in southeast Alaska. This latter may have resulted in part in the effort late in the season to bring packs up to the guarantee. There was a slight falling off in the number of humpbacks used in southeast Alaska; reds held their own in this section, but scarcely did so in central Alaska. The shortage of reds in the Nushagak section led to an increased pack of the inferior species there.

APPARATUS AND CATCH.

The tables giving the number of salmon caught in 1912, by apparatus and species alone, for each geographic section, show an interesting shift in the application of gear. The percentage of the total catch of all species, for the three principal forms of gear, stands in round numbers for the two seasons (1911 and 1912), as follows:

PERCENTAGE OF TOTAL CATCH OF SALMON BY THREE PRINCIPAL FORMS OF GEAR.

Apparatus.	Southeast Alaska.		Central Alaska.		Western Alaska.	
	1911	1912	1911	1912	1911	1912
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Seines..................................	62	50	50	40	....	....
Traps...................................	33	47	40	50	5	6
Gill nets................................	4	2	9	9	94	93

In southeast Alaska, whereas in 1911 60 per cent of the pinks or humpbacks were taken in seines, in 1912 slightly under 49 per cent were so taken. Or, stating it somewhat differently, compared with the catch of 1911, in southeast Alaska, that by seines shows a decrease of 2,401,099 fish, that by gill nets a decrease of 264,891, that by hand lines a slight increase, and that by traps an increase of 4,494,295

fish, or more than 48 per cent. There was an increase of 15 per cent in the catch of cohos, of nearly 90 per cent in dog salmon, a slight decrease (about 4 per cent) in the humpback, and an increase of 5 per cent in the catch of sockeyes. The total catch in southeast Alaska increased but 6 per cent over that of 1911. Had it not been for the phenomenally large catch of dog salmon no increase in the total catch for southeast Alaska would have resulted.

In central Alaska the seine catch shows an increase of 8 per cent, the gill-net catch an increase of 41 per cent, while the trap catch shows an increase of more than 81 per cent. There was an increase of 9 per cent in the catch of cohos, of 252 per cent in chums, and a very slight decrease (less than one-fifth of 1 per cent) in sockeyes.

In western Alaska the gill-net catch shows an increase of more than 128 per cent, and the trap catch an increase of 208 per cent. Several causes perhaps entered into this result. It was brought about perhaps primarily by the development of the independent trap, probably in part the result of the multiplication of canneries, including some plants that depended entirely on purchasing fish from independent fishermen. Another cause is the increasing knowledge of the runs or movements of the fish, permitting a more ready selection of good trap sites. A third may be found in the application of the floating trap which has lately been perfected. Still another influence was the strike early in the season, though this will doubtless have a greater effect the next season than it had the last. The necessity for a dependable source from which to obtain the raw material is essential to the life of the canning industry.

SALMON TAKEN IN 1912, BY SPECIES AND APPARATUS, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Seines:	*Number.*	*Number.*	*Number.*	*Number.*
Coho, or silver	497,091	46,738		543,829
Dog, or chum	3,247,317	165,045		3,412,362
Humpback, or pink	9,886,211	992,638		10,878,849
King, or spring	1,061	968		2,029
Red, or sockeye	1,117,090	2,425,394		3,542,484
Total	14,748,770	3,630,783		18,379,553
Gill nets:				
Coho, or silver	142,237	62,814	188,347	393,398
Dog, or chum	125,582	2,142	746,849	874,573
Humpback, or pink	21,887	51,913	444,640	518,440
King, or spring	83,779	28,232	94,561	206,572
Red, or sockeye	394,310	678,145	19,359,133	20,431,588
Total	767,795	823,246	20,833,530	22,424,571
Traps:				
Coho, or silver	392,206	91,934	24,015	508,155
Dog, or chum	1,722,367	202,983	146,448	2,071,798
Humpback, or pink	10,227,737	1,677,820	731,500	12,637,057
King, or spring	41,054	25,516	4,107	70,677
Red, or sockeye	1,452,067	2,593,052	588,350	4,633,469
Total	13,835,431	4,591,305	1,494,420	19,921,156

SALMON TAKEN IN 1912, BY SPECIES AND APPARATUS, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
	Number.	*Number.*	*Number.*	*Number.*
Lines:				
Coho, or silver	15,059			15,059
King, or spring	197,952			197,952
Total	213,011			213,011
Spears:				
Red, or sockeye	654			654
Total:				
Coho, or silver	1,046,593	201,486	212,362	1,460,441
Dog, or chum	5,095,266	370,170	893,297	6,358,733
Humpback, or pink	20,135,835	2,722,371	1,176,140	24,034,346
King, or spring	323,846	54,716	98,668	477,230
Red, or sockeye	2,964,121	5,696,591	19,947,483	28,608,195
Grand total	29,565,661	9,045,334	22,327,950	60,938,945

Relation of gear to conservation of the fishery.—The effect upon the fishery of the various devices used in capturing the fish has long been a much-debated question. The recent extension in the use of traps in southeast Alaska has raised another and different question, namely, the employment of labor as affected by the stationary and movable gear, respectively. An examination of the statistics as set forth in the tables given in this report shows that about one-third of the total number of salmon taken in 1912 were taken in traps, when seven years ago less than one-fifth were so taken. It is further revealed that the increase in the use of the trap has been in central and southeastern Alaska only, the percentage having more than doubled in the latter section and almost doubled in the former. It will be further noted that the relation of the trap varies with the species; for the period it s lowest for kings and highest for cohos, but in 1912 highest for pink salmon, of which species more were taken in traps last season than by all other means combined.

The propriety of the use of any particular fishing device, excluding the labor question, must be determined by the answers to the following questions:

1. Is its operation readily inspected and regulated?

2. Does it enable the fish secured to be put on the market in the best possible condition?

3. Does it result in loss of any portion of the fish it is designed to capture?

4. Does the appliance cause the loss of, or affect injuriously, any other species or the young of the species caught?

Salmon fishing, as ordinarily conducted, is peculiar in that only adult fish are taken by the gear used. It is true that to a slight degree yearling fish may be destroyed sometimes, as for example, in the seining on Karluk beach, or occasionally in brailing a trap, but this damage is practicably negligible.

Occasionally in certain locations traps are said to cause a considerable destruction to certain flounders and other species at present not used. One of the species commonly taken in traps is the dolly varden trout. It is conceded that this species is a nuisance, falling into the same class as the dogfish, and the damage it inflicts upon other fish of greater worth more than compensates for any value the dolly varden have.

Before a final decision can be rendered as to the relative effectiveness of traps and of movable gear, definite statistics are required as to certain movements of salmon:

1. To what extent do they travel at night in their migratory movement toward the rivers?

2. To what extent do they tend to distribute toward the center of channels?

3. What are the movements of the fish upon striking the web and what effect has the recurved hook or "jigger"?

4. To what degree is the entrance into streams delayed by various conditions, such as low water?

5. To what extent do the fish wander after once reaching the mouth of a stream?

Whatever may be the ultimate answers to these questions, two important factors remain in favor of the use of stationary gear: First, the trap may be so constructed as to hold the fish living till the cannery is ready to use them, and, second, it admits of convenient and comparatively inexpensive inspection and regulation.

The necessity for canning salmon in good condition involves some urgent questions. Much was accomplished toward this end by the enactment of the 48-hour law. While it has not been possible strictly to enforce this law, nor is the law itself entirely applicable or adequate, it has nevertheless served to call attention to an evil and has brought about a degree of correction. The irregularity of the runs of salmon is such that some elastic gear, i. e., a form of apparatus that will hold a short heavy run in a manner to permit its effective utilization without loss either in quantity or quality of product, is a necessity; any form of gear which kills the fish in its capture should be supplanted by a form which will hold fish alive.

The second advantage of the stationary gear is in its stability and consequent amenability to regulation.

There are in southeast Alaska alone some three hundred localities where salmon are taken. Many of these are at the head of deep bays or fiords, distantly removed from usual routes of travel, and visited by none but those engaged in the fishery, not infrequently by a single crew with mutual interests among the members. In all discussions regarding the enforcement of restrictive regulations limiting the kinds of gear to be used, the places in which and the times when they may be used, the fact that the fishery, or at least the fishery by

movable gear, is carried on in numerous remote and difficultly accessible places contemporaneously must be kept in mind. In all Alaska, not including the larger rivers such as the Yukon, some 400 different fishing places are reported. If each isolated trap or group of traps is regarded as a separate locality and complete report were made in all sections of each particular locality or stream fished, the number would be considerably increased. These fishing places are scattered over some 20,000 miles of coast line, much of it outside water navigable only by substantial boats in time of rough weather.

The impracticability of subjecting such a region to the effective surveillance of wardens, unless supported by a healthy and active public sentiment, is at once apparent. Whatever legislation may be enacted, so long as small movable gear, such as the ordinary seines and gillnets, may be owned and used and all fish taken, sold, and shipped, the ultimate fate of the fishery will remain in the hands of the operators of such gear. A regulation of stationary apparatus can be enforced within a reasonable expenditure even with the apparatus in the hands of the irresponsible or the malicious; regulation of the nonstationary apparatus must be effected primarily by public sentiment.

SALMON TAKEN SINCE 1906, SHOWN BY APPARATUS, SPECIES, AND YEAR, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

SOUTHEAST ALASKA.

Years and apparatus.	Coho.	Dog.	Pink.	King.	Sockeye.	Total.
1906:						
Traps	256,708	355,048	1,377,439	4,335	615,261	2,608,791
Other gear	403,263	1,215,661	5,822,373	90,252	1,908,595	9,440,144
Total	659,971	1,570,709	7,199,812	94,587	2,523,856	12,048,935
1907:						
Traps	139,783	158,170	3,438,335	26,835	615,684	4,378,807
Other gear	387,958	1,176,120	8,632,580	93,729	1,653,663	11,944,050
Total	527,741	1,334,290	12,070,915	120,564	2,269,347	16,322,857
1908:						
Traps	119,034	368,709	5,102,843	3,448	486,646	6,080,680
Other gear	359,498	1,434,770	8,960,049	127,620	2,073,983	12,955,920
Total	478,532	1,803,479	14,062,892	131,068	2,560,629	19,036,600
1909:						
Traps	112,213	337,395	3,628,940	5,107	923,816	5,007,471
Other gear	252,022	396,815	5,699,427	203,558	1,779,063	8,330,885
Total	364,235	734,210	9,328,367	208,665	2,702,879	13,338,356
1910:						
Traps	165,023	437,726	3,151,684	2,546	860,737	4,617,716
Other gear	493,511	1,595,023	6,261,089	256,642	2,126,149	10,732,414
Total	658,534	2,032,749	9,412,773	259,188	2,986,886	15,350,130
1911:						
Traps	276,206	734,827	7,373,011	18,418	938,674	9,341,136
Other gear	631,212	1,982,064	13,693,819	256,634	1,882,817	18,446,546
Total	907,418	2,716,891	21,066,830	275,052	2,821,491	27,787,682
1912:						
Traps	392,206	1,722,367	10,227,737	41,054	1,452,067	13,835,431
Other gear	654,387	3,372,899	9,908,098	282,792	1,512,054	15,730,230
Total	1,046,593	5,095,266	20,135,835	323,846	2,964,121	29,565,661
Period 1906-1912:						
Traps	2,245,622	4,114,242	34,299,989	101,743	5,892,885	46,654,481
Other gear	3,181,851	11,173,352	58,977,435	1,311,227	12,936,324	87,580,189
Total	5,427,473	15,287,594	93,277,424	1,412,970	18,829,209	134,234,670

SALMON TAKEN SINCE 1906, SHOWN BY APPARATUS, SPECIES, AND YEAR, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

CENTRAL ALASKA.

Years and apparatus.	Coho.	Dog.	Pink.	King.	Sockeye.	Total.
1906:						
Traps	93,485		64,100	16,858	1,487,606	1,662,049
Other gear	23,738			11,509	4,510,073	4,545,320
Total	117,223		64,100	28,367	5,997,679	6,207,369
1907:						
Traps	163,076		6,420	36,791	2,711,142	2,917,429
Other gear	63,759		252,373	31,037	3,926,718	4,273,887
Total	226,835		258,793	67,828	6,637,860	7,191,316
1908:						
Traps	90,616		375,140	17,216	2,285,401	2,768,373
Other gear	60,847		268,466	21,379	3,222,214	3,572,906
Total	151,463		643,606	38,595	5,507,615	6,341,279
1909:						
Traps	89,918		3,740	44,632	2,152,555	2,290,845
Other gear	52,258		127,549	21,966	2,526,817	2,728,590
Total	142,176		131,289	66,598	4,679,372	5,019,435
1910:						
Traps	115,922	1,318	273,023	34,007	2,095,563	2,519,833
Other gear	83,028		375,041	17,593	2,526,718	3,002,380
Total	198,950	1,318	648,064	51,600	4,622,281	5,522,213
1911:						
Traps	89,633	20,476	259,072	34,017	2,237,586	2,640,784
Other gear	94,325	84,516	248,484	24,323	3,468,929	3,920,577
Total	183,958	104,992	507,556	58,340	5,706,515	6,561,361
1912:						
Traps	91,934	202,983	1,677,820	25,516	2,593,052	4,591,305
Other gear	109,552	167,187	1,044,551	29,200	3,103,539	4,454,029
Total	201,486	370,170	2,722,371	54,716	5,696,591	9,045,334
Period 1906–1912:						
Traps	734,584	224,777	2,659,315	209,037	15,562,905	19,390,618
Other gear	487,507	251,703	2,316,464	157,007	23,285,008	26,497,689
Total	1,222,091	476,480	4,975,779	366,044	38,847,913	45,888,307

WESTERN ALASKA.

Years and apparatus.	Coho.	Dog.	Pink.	King.	Sockeye.	Total.
1906:						
Traps	1,500	466,632	352,526	6,530	791,166	1,618,354
Other gear	206,110	1,222,043	91,561	138,343	10,224,060	11,882,117
Total	207,610	1,688,675	444,087	144,873	11,015,226	13,500,471
1907:						
Traps	29,199	36,141	1,500	5,011	1,078,869	1,150,720
Other gear	109,650	472,586	337,514	134,391	9,181,034	10,235,175
Total	138,849	508,727	339,014	139,402	10,259,903	11,385,895
1908:						
Traps	20,000	114,534	261,519	4,856	860,516	1,261,425
Other gear	86,088	340,309	138,138	87,174	16,013,966	16,665,675
Total	106,088	454,843	399,657	92,030	16,874,482	17,927,100
1909:						
Traps	9,930	101,456	15	3,096	508,011	622,508
Other gear	71,393	346,340	31,811	128,893	15,133,872	15,712,309
Total	81,323	447,796	31,826	131,989	15,641,883	16,334,817
1910:						
Traps	6,340	58,039	513,072	4,382	326,833	908,666
Other gear	132,860	252,179	149,057	97,373	11,266,776	11,898,245
Total	139,200	310,218	662,129	101,755	11,593,609	12,806,911

SALMON TAKEN SINCE 1906, SHOWN BY APPARATUS, SPECIES, AND YEAR, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

WESTERN ALASKA—Continued.

Years and apparatus.	Coho.	Dog.	Pink.	King.	Sockeye.	Total.
1911:						
Traps	8,000	173,823	....	3,541	299,552	484,916
Other gear	121,971	174,043	91,764	109,722	8,644,414	9,141,914
Total	129,971	347,866	91,764	113,263	8,943,966	9,626,830
1912:						
Traps	24,015	146,448	731,500	4,107	588,350	1,494,420
Other gear	188,347	746,849	444,640	94,561	19,359,133	20,833,530
Total	212,362	893,297	1,176,140	98,668	19,947,483	22,327,950
Period 1906-1912:						
Traps	98,984	1,097,073	1,860,132	31,523	4,453,297	7,541,009
Other gear	916,419	3,554,349	1,284,485	790,457	89,823,255	96,368,965
Total	1,015,403	4,651,422	3,144,617	821,980	94,276,552	103,909,974

SUMMARY OF SALMON TAKEN IN ALASKA, 1906 TO 1912, WITH TOTALS AND PERCENTAGES, SHOWING NUMBER, BY SPECIES, TAKEN BY TRAPS AND BY MOVABLE GEAR.

Years and apparatus.	Coho.	Dog.	Pink.	King.	Sockeye.	Total.	Percentage of total.
1906:							
Traps	351,693	821,680	1,794,065	27,723	2,894,033	5,889,194	18
Other gear	633,111	2,437,704	5,913,934	240,104	16,642,728	25,867,581	81
Total	984,804	3,259,384	7,707,999	267,827	19,536,761	31,756,775	....
1907:							
Traps	332,058	194,311	3,446,255	68,637	4,405,695	8,446,956	24
Other gear	561,367	1,648,706	9,222,467	259,157	14,761,415	26,453,112	76
Total	893,425	1,843,017	12,668,722	327,794	19,167,110	34,900,068	....
1908:							
Traps	229,650	483,243	5,739,502	25,520	3,632,563	10,110,478	23
Other gear	506,433	1,775,079	9,366,653	236,173	21,310,163	33,194,501	76
Total	736,083	2,258,322	15,106,155	261,693	24,942,726	43,304,979	....
1909:							
Traps	212,061	438,851	3,632,695	52,835	3,584,382	7,920,824	22
Other gear	375,673	743,155	5,858,787	354,417	19,439,752	26,771,784	77
Total	587,734	1,182,006	9,491,482	407,252	23,024,134	34,692,608	....
1910:							
Traps	287,285	497,083	3,937,779	40,935	3,283,133	8,046,215	24
Other gear	709,399	1,847,202	6,785,187	371,608	15,919,643	25,633,039	76
Total	996,684	2,344,285	10,722,966	412,543	19,202,776	33,679,254	....
1911:							
Traps	373,839	929,126	7,632,083	55,976	3,475,812	12,466,836	28
Other gear	847,508	2,240,623	14,034,067	390,679	13,996,160	31,509,037	71
Total	1,221,347	3,169,749	21,666,150	446,655	17,471,972	43,975,873	....
1912:							
Traps	508,155	2,071,798	12,637,057	70,677	4,633,469	19,921,156	32
Other gear	952,286	4,286,935	11,397,289	406,553	23,974,726	41,017,789	67
Total	1,460,441	6,358,733	24,034,346	477,230	28,608,195	60,938,945	....
Period 1906-1912:							
Traps	3,079,190	5,436,092	38,819,436	342,303	25,909,087	73,586,108	26
Other gear	4,585,777	14,979,404	62,578,384	2,258,691	126,044,587	210,446,843	74
Total	7,664,967	20,415,496	101,397,820	2,600,994	151,953,674	284,032,951	....
Percentages of total:							
Traps	40	26	38	13	17	....	....
Other gear	60	73	62	87	83	....	....

Troll fishing for salmon.—The troll fishing for salmon continues to develop. At various points in southeast Alaska this fishery is now successfully prosecuted for both king and coho salmon. The waters adjacent to Forrester Island are perhaps the most productive. During the past season this fishery attracted a large number of fishermen, who established a camp on the island and carried on the fishing from that point as a base.

Forrester Island, together with Wolf Rock and Lowrie Islands, was set aside as a bird-breeding reserve by Executive order of January 11, 1912, to be under the control of the Department of Agriculture. The islands are within the boundaries of the Tongass National Forest, so the administration is placed under the joint authority of the Forest Service and the Bureau of Biological Survey of the Department of Agriculture.

In 1912 a warden from the latter bureau was detailed to look after the reservation. He arrived on the ground June 21 and found a considerable body of people located on the island for the purpose of prosecuting the fishery or of profiting from it indirectly. Assisted by the law-abiding element he rapidly brought conditions into shape, enforcing appropriate police regulations to maintain health, decency, and good order and to insure equal opportunity and fair dealing for those engaged in the arduous and hazardous work of capturing the fish.

This fishing is carried on by two classes of boats—power boats and rowboats. The former are not favored, since it is thought they are more liable to injure the fish without holding them. Moreover, this is a fishery in which the individual of small means can find his opportunity. All it requires is an ordinary rowboat and troll line. It is essentially an investment of labor instead of capital. Out of 294 permits issued only about 8 went to power boats. It has been recommended that no power boat be permitted to engage in this fishery.

The hours established for operation were from 3 a. m. to 9 p. m. By the latter time all boats were required to report and if any were missing, search was made at once for them. This precaution saved several lives, in addition to giving all an equal chance in the profits.

Ten vessels were engaged in transporting the fish to the mild-curing stations. The price paid for king salmon was $1 each for red-meated and 30 cents for white. The highest record made by a single boat was something over 1,800 for the season; the highest yield for a single day's work by one man was 161 fish. On an average the weather permits fishing to be carried on only about four days a week, and about 15 fish per day is an average catch.

Most of the fishing is done with spoons, but herring bait is sometimes used. The herring so used are mainly taken in the vicinity or

in the neighborhood of Howkan with rakes. The salmon are taken in depths of from 3 to 20 fathoms.

Coho and king salmon are the only species so far taken by this method. This is perhaps due to the fact that these species feed on the herring inshore to a greater extent. The smaller species probably feed less on herring and more on smaller species, such as sand lances, and it is quite possible that they feed less in the inside waters. But since the king salmon were not taken in Alaska by hook and line until in recent years, it may be that means will later be found to develop a similar fishery for the other species. An excellent field for investigation leading to such results remains open.

CANNING.

Conditions and events of the season.—The season of 1912 reversed in large measure the successes of 1911. While those companies making the greater part of their pack from red salmon were prosperous, those depending upon the pink and chum packs lost correspondingly. Twenty-three new plants were inaugurated, 20 of them in the southeast or pink-salmon region, and none in Bering Sea, where the heavy run of reds occurred. A few of these new plants were offshoots of established concerns or extensions and conversions of pickling plants, but most of them were new firms entering the field as such for the first time. It is expected that several of these plants will be closed for the season of 1913, partly in view of the heavy run of pinks due in Puget Sound this year.

In the matter of accidents and casualties the industry fared well. The warehouse belonging to the cannery in Hidden Inlet collapsed, but the loss of stock was slight. Two fatalities occurred in the Yakutat region by drowning. These are the only accidents of note reported.

The phenomenal success of the floating cannery *Glory of the Seas* last season found fewer imitators than was anticipated. Only this vessel and a second, the *William H. Smith*, were operated as such. The active demand for pink fish induced by the many new concerns and the subsequent low market price reversed the 1911 results, and it is not expected that any further attempt will be made to exploit this form of cannery in the near future.

The use of the "sanitary can" was further extended. It is probable that it will entirely displace the solder can by another season.

It seems proper in this place to again urge the desirability of greater care in putting on the market only a wholesome product and that in an attractive form. During the past season many samples of salmon which had been questioned under the pure-food law came into this Bureau for criticism as to quality and branding. Not all of this was packed in Alaska, but the qualities which make the contents of a package wholesome and attractive in one place apply to

every other. It is apparent that under the "sanitary" system of packing more care must be taken to avoid tainted fish. In the old solder process the first cooking to a degree vaporized the more volatile products of decomposition, those which affect the sense of smell, and they were blown off when the cans were vented. In the sanitary process these products are retained and appear when the cans are opened. It is to be presumed that no reputable firm intentionally packs fish which will "smell" in the package, and that such a product would be turned out only through careless or inefficient supervision. Firms operating more than one plant would do well to use a distinguishing mark that will make any can traceable to the particular cannery producing it.

It is believed that the ruinous price recently reached by pink and chum salmon is due in large part to the carelessness in preparing those grades in the past. Both of these species spawning near the sea, the fish are more mature at the time they are taken than are the other species. This results in large numbers being taken, particularly by the seiners who work in the streams or near their mouths, after they are so mature as to be really unfit for canning. When to this is coupled the fact that the pink salmon softens under the best conditions soon after death, it is readily comprehended why in the wholesale machine methods used the product is often unsatisfactory. It is hardly to be expected that, after lying for a time in the bilges of a seine boat, being bruised and punctured by pewing from the boat to a lighter, thence to the dock and again to the butcher, mangled in the chink, cut odd lengths and obliquely on the cutter, and finally stuffed in the can under pressure at the filler, the much abused humpback should present, when dropped from the can to the serving dish, an appearance of quality that will compete advantageously with the more favored red salmon. Of necessity from its pale color the pink salmon must undersell the red, yet it requires greater care to turn it into a wholesome and a reasonably attractive canned product. But in spite of its small size and lack of firmness and color it can be made up into a neat package.

The use of stream fish, "slabsides," that are either delayed runs or fish chased out of the streams, should be discontinued; the substance of the meat of these fish has gone into the reproductive elements that are thrown in the gurry. It is a fraud on the consumer to offer it for sale.

There should be more care used in the handling of the fish prior to reaching the dock. Fish taken in seines or gill nets, perhaps, necessarily are handled more roughly or frequently than trap fish, but this evil can be minimized. Especially the pewing can be more carefully done. No fish should be pewed in the body prior to butchering; if alive the wound becomes engorged with blood, and if dead the skin and peritoneum are broken, allowing all the poison and

bacteria of the slime and digestive tract to be absorbed by the flesh. While these membranes are intact the meat of the fish is practically sealed from contamination, and decay is postponed much beyond the period required to render exposed flesh unwholesome.

The machinery in use for cleaning the fish and filling the cans was designed for the firm-fleshed fish. Perhaps any fish in proper condition can be taken care of by it but with pink salmon somewhat softened the machinery too often turns out what has rather the appearance of scrap. This may be quite as wholesome and even as well flavored as the more solid sections, but it is not attractive in appearance, and until a product attractive both in appearance and flavor can be offered, there is not likely to be a permanent advance in price with the present quantities put on the market. A certain number of inexperienced housekeepers, supplementing the demand by those whose means permit no choice involving a higher price, will always furnish a limited market for a low-grade product; but to extend the market and advance the price requires a product so satisfactory that the first purchase leads to continued use. The pale salmon are capable, with proper care, of conversion into such a product. It may require additional expense, mainly in better supervision and more uniform adjustment of the supply of raw material to the capacity of the plant. It may also require the elimination of the long haul, and certainly of the ripe fish now brought in toward the close of the season.

COMPANIES CANNING SALMON IN ALASKA, HOME OFFICE, NUMBER OF CANNERIES OPERATED, LOCATION AND NUMBER OF TRAPS OPERATED BY EACH.

Names.	Home office.	Canneries.	Location.	Traps.
Southeast Alaska:				
Admiralty Trading Co.[a]	1020 Yeon Building Portland, Oreg.	1	Gambier Bay	[b] 5
Alaska Fish Co	556 Colman Building, Seattle, Wash.	1	Floating cannery, "Glory of the Seas."	
Alaska Pacific Fisheries	209 Mutual Life Building, Seattle, Wash.	3	Chilkoot Inlet Yes Bay Chomley	[c] 6 [d] 7 [e] 3
Alaska Packers Association.	Wells, Fargo Building, San Francisco, Cal.	2	Loring Wrangell	[d] 7 [c] 8
Alaska Sanitary Packing Co.[a]	300 Eiler Building, Seattle, Wash.	1	do	1
Astoria & Puget Sound Canning Co.	South Bellingham, Wash	1	Excursion Inlet	5
F. C. Barnes Co	428 Worcester Building, Portland, Oreg.	1	Lake Bay	4
Canoe Pass Packing Co.[a]	415 Spalding Building, Portland, Oreg.	1	Canoe Pass	
Deep Sea Salmon Co	306 Lowman Building, Seattle, Wash.	1	Ford Arm	
Fidalgo Island Packing Co.	Anacortes, Wash	1	Ketchikan	5
Hawk Fish Co	Alaska Building, Seattle, Wash.	1	Hawk Inlet	4
Hidden Inlet Canning Co	Fairfield Block, Vancouver, B. C.	1	Hidden Inlet	2
Herbert Hume Packing Co.[a]	615 Hodge Building, Seattle, Wash.	1	Nakat Inlet	2
Hoonah Packing Co.[a]	Port Townsend, Wash	1	Hoonah	4
Irving Packing Co.[a]	568 Colman Building, Seattle, Wash.	1	Karheen	4
Kake Packing Co.[a]	Care G. W. Sanborn, Astoria, Wash.	1	Kake	1

[a] New cannery.
[b] One floating.
[c] Two floating.
[d] Six floating.
[e] Floating.

COMPANIES CANNING SALMON IN ALASKA, HOME OFFICE, NUMBER OF CANNERIES OPERATED, LOCATION, AND NUMBER OF TRAPS OPERATED BY EACH—Continued.

Names.	Home office.	Canneries.	Location.	Traps.
Southeast Alaska—Continued.				
The Kasaan Co	412 Colman Building, Seattle, Wash.	1	Kasaan	[a] 4
Kuiu Island Packing Co.[b]	do	1	Beauclaire	
Lindenberger Packing Co.	334 Globe Building, Seattle, Wash.	2	Roe Point Craig[b]	[a] 4 2
Metlakahtla Industrial Co.	Metlakahtla, Alaska	1	Metlakahtla	
George T. Myers & Co	568 Colman Building, Seattle, Wash.	1	Chatham	8
North Pacific Trading & Packing Co.	307 Crocker Building, San Francisco, Cal.	1	Klawak	
Northwestern Fisheries Co	Maynard Building, Seattle, Wash.	4	Hunter Bay Quadra Santa Ana Dundas Bay	[c] 1
Oceanic Packing Co.[b]	556 Colman Building, Seattle, Wash.	1	Waterfall	1
Pacific American Fisheries	South Bellingham, Wash	1	Excursion Inlet	19
Pacific Coast & Norway Packing Co.	Care of Kildall Fishing & Packing Co., Seattle, Wash.	1	Petersburg	
Pillar Bay Packing Co	306 Lowman Building, Seattle, Wash.	1	Pillar Bay	2
Point Warde Packing Co.[b]	412 Colman Building, Seattle, Wash.	1	Point Warde	3
Pure Food Fish Co.[b]	Ketchikan, Alaska	1	Ketchikan	
Revilla Fish Products Co.[b]	do	1	do	
Sanborn-Cram Co.[b]	South Bend, Wash	1	Burnett Inlet	[c] 1
Shakan Salmon Co	412 Colman Building, Seattle, Wash.	1	Shakan	2
Skowl Arm Packing Co. (formerly L. Gustave & Co.)	1313 Alaska Building, Seattle, Wash.	1	Skowl Arm	
St. Elias Packing Co	412 Colman Building, Seattle, Wash.	1	Dry Bay	
Starr-Collinson Packing Co.[b]	428 Worcester Building, Portland, Oreg.	1	Moira Sound	
Sunny Point Packing Co.[b]	Ketchikan, Alaska	1	Chomley	
Swift, Arthur & Co.[b]	16 Colman Dock, Seattle, Wash.	1	Heceta Island	
Taku Canning & Cold Storage Co.	210 Mutual Life Building, Seattle, Wash.	1	Taku Harbor	[d] 8
Tee Harbor Packing Co	Port Blakeley, Wash	1	Tee Harbor	6
Thlinket Packing Co	1006 Yeon Building, Portland, Oreg.	1	Funter Bay	16
Walsh-Moore Canning Co.[b]	Care of Phil. J. Brady, Seattle, Wash.	1	Ward Cove	
Weiding & Independent Fisheries Co.[b]	Seattle, Wash	1	Floating cannery, "William H. Smith."	
Weise Packing Co.[b]	502 Central Building, Seattle, Wash.	1	Rose Inlet	2
Yakutat & Southern Ry. Co.	412 Colman Building, Seattle, Wash.	1	Yakutat	
Central Alaska:				
Alaska Packers Association	Wells, Fargo Building, San Francisco, Cal.	4	Kasilof Larsen Bay Alitak Chignik	14 [c] 1 [e] 12
Columbia River Packers Association.	Astoria, Oreg	1	do	
Fidalgo Island Packing Co.[b]	Anacortes, Wash	1	Port Graham	2
Kadiak Fisheries[b]	209 First Avenue South, Seattle, Wash.	1	Kodiak	
Libby, McNeil & Libby[b]	Seattle, Wash	1	Kenai	1
Northwestern Fisheries Co	Maynard Building, Seattle, Wash.	4	Orca Kenai Uyak Chignik	 10 [e] 13
Pacific American Fisheries	South Bellingham, Wash	1	King Cove	4
Seldovia Salmon Co	554 Henry Building, Seattle, Wash.	1	Seldovia	
Western Alaska:				
Alaska Fishermen's Packing Co.	Astoria, Oreg	2	Nushagak Bay Kvichak Bay	

[a] Three floating.
[b] New cannery.
[c] Floating.
[d] Two floating.
[e] One floating.

COMPANIES CANNING SALMON IN ALASKA, HOME OFFICE, NUMBER OF CANNERIES OPERATED, LOCATION, AND NUMBER OF TRAPS OPERATED BY EACH—Continued.

Names.	Home office.	Canneries.	Location.	Traps.
Western Alaska—Continued.				
Alaska Packers Association.	Wells, Fargo Building, San Francisco, Cal.	8	Nushagak Bay (2)	5
			Kvichak Bay (2)	1
			Naknek River (3)	
			Ugaguk River	
Alaska-Portland Packers Association.	1107 Yeon Building, Portland, Oreg.	1	Nushagak Bay	3
Alaska Salmon Co	112 Market Street, San Francisco, Cal.	1	do	
Bristol Bay Packing Co	95 Market Street, San Francisco, Cal.	1	Kvichak Bay	
Columbia River Packers Association.	Astoria, Oreg	1	Nushagak Bay	
Midnight Sun Packing Co	4107 Linden Avenue, Seattle, Wash.	1	Kotzebue Sound	2
Naknek Packing Co	72 Main Street, San Francisco, Cal.	1	Naknek River	
North Alaska Salmon Co	110 Market Street, San Francisco, Cal.	4	Ugaguk River	
			Lockanok	
			Kvichak Bay	1
			Nushagak Bay	
Northwestern Fisheries Co.	Maynard Building, Seattle, Wash.	1	do	
Red Salmon Canning Co	72 Main Street, San Francisco, Cal.	1	Ugashik River	
Pacific American Fisheries.[a]	South Bellingham, Wash	1	Port Moller	

[a] Cannery built, but no pack this year.

INVESTMENT, ETC., IN THE SALMON-CANNING INDUSTRY IN 1912.

Items.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Canneries	51		14		22		87	
Working capital		$4,911,317		$3,468,989		$5,589,179		$13,969,485
Value of plants		4,079,074		1,727,767		3,164,665		8,971,506
Wages paid		2,231,397		1,015,388		2,360,833		5,607,618
Vessels:								
Steamers and launches over 5 tons	148	787,755	46	410,084	49	622,810	243	1,820,649
Tonnage	2,706		2,196		2,739		7,641	
Launches under 5 tons	58	81,700	16	19,026	14	20,683	88	121,409
Tonnage	176		43		45		264	
Sailing	6	215,350	11	375,401	33	802,819	50	1,393,570
Tonnage	9,005		19,424		44,798		73,227	
Boats, sail and row	757	55,597	429	30,194	1,083	170,886	2,269	256,677
Lighters	236	117,692	180	86,188	141	109,672	557	313,552
Pile drivers	41	120,891	29	69,459	19	32,700	89	223,050
Apparatus:								
Haul seines	97	28,710	49	16,420			146	45,130
Fathoms	13,365		11,069				24,434	
Purse seines	249	118,777	16	5,540	2	440	267	124,757
Fathoms	48,316		3,430		440		52,186	
Gill nets	377	51,495	161	22,593	1,416	123,967	1,954	198,055
Fathoms	51,480		23,950		240,795		316,225	
Traps, driven	144	405,068	82	204,012	12	31,076	238	640,156
Traps, floating	32	62,446	3	11,200			35	73,646
Dip nets	19	35					19	35
Total		13,267,304		7,462,261		13,029,730		33,759,295

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1912.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Fishermen:				
Whites	1,004	774	2,013	3,791
Indians	1,403	205	47	1,655
Japanese	2	......	......	2
Total	2,409	979	2,060	5,448
Shoresmen:				
Whites	1,109	423	1,316	2,848
Indians	1,357	277	387	2,021
Chinese	1,242	533	1,211	2,986
Japanese	1,393	463	1,397	3,253
Miscellaneous	47	14	475	536
Total	5,148	1,710	4,786	11,644
Transporters:				
Whites	303	122	182	607
Indians	5	......	......	5
Japanese	......	1	......	1
Total	308	123	182	613
Grand total:				
Whites	2,416	1,319	3,511	7,246
Indians	2,765	482	434	3,681
Chinese	1,242	533	1,211	2,986
Japanese	1,395	464	1,397	3,256
Miscellaneous	47	14	475	536
Total	7,865	2,812	7,028	17,705

OUTPUT OF CANNED SALMON IN 1912, BY SPECIES AND SIZE OF CASES.[a]

Products.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Cases.	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*
Coho, or silver:								
½-pound flat	2,719	$15,063	......	......	......	......	2,719	$15,063
1-pound flat	17	85	......	......	......	......	17	85
1-pound tall	129,045	571,287	19,722	$89,264	14,695	$65,678	163,462	726,229
Total	131,781	586,435	19,722	89,264	14,695	65,678	166,198	741,377
Dog, or chum:								
½-pound flat	2,795	10,806	......	......	......	......	2,795	10,806
1-pound tall	594,117	1,405,611	29,456	72,583	38,265	95,130	661,838	1,573,324
Total	596,912	1,416,417	29,456	72,583	38,265	95,130	664,633	1,584,130
Humpback, or pink:								
½-pound flat	13,712	58,614	......	......	......	......	13,712	58,614
1-pound tall	1,033,734	2,641,229	137,884	355,438	94,808	241,317	1,266,426	3,237,984
Total	1,047,446	2,699,843	137,884	355,438	94,808	241,317	1,280,138	3,296,598
King, or spring:								
½-pound flat	5,151	38,092	......	......	......	......	5,151	38,092
1-pound tall	2,053	10,793	14,358	79,904	21,755	114,542	38,166	205,239
Total	7,204	48,885	14,358	79,904	21,755	114,542	43,317	243,331
Red, or sockeye:								
½-pound flat	22,514	151,347	4,435	40,802	1,075	9,258	28,024	201,407
1-pound flat	16,242	100,460	......	......	......	......	16,242	100,460
1-pound tall	211,549	1,175,448	419,207	2,339,500	1,225,333	6,609,666	1,856,089	10,124,614
Total	250,305	1,427,255	423,642	2,380,302	1,226,408	6,618,924	1,900,355	10,426,481
Grand total	2,033,648	6,178,835	625,062	2,977,491	1,395,931	7,135,591	4,054,641	16,291,927

[a] Half-pound cases contain forty-eight ½-pound cans, but for convenience in comparing with the 1-pound cases, which contain 48 cans, they have been reduced one-half in number, thus equaling in weight the 1-pound cases.

OUTPUT OF CANNED SALMON, 1906–1912.[a]

Products.	1906	1907	1908	1909	1910	1911	1912	Total.
Coho, or silver:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
½-pound flat	1,609	485	105		163	1,574	2,719	6,655
1-pound flat	15,944	3,933	2,414	1,206	2,249	1,075	17	26,838
1-pound tall	91,582	80,772	66,309	55,350	111,614	131,259	163,462	700,348
Total	109,135	85,190	68,828	56,556	114,026	133,908	166,198	733,841
Dog, or chum:								
½-pound flat		246					2,795	3,041
1-pound flat		664	107			7,245		8,016
1-pound tall	254,812	183,262	218,406	120,712	254,218	316,550	661,838	2,009,798
Total	254,812	184,172	218,513	120,712	254,218	323,795	664,633	2,020,855
Humpback, or pink:								
½-pound flat	1,470	8,795			3,188	4,836	13,712	32,001
1-pound flat	2,618	7,406	569		7,900	9,437		27,930
1-pound tall	344,209	545,772	643,564	464,873	543,233	991,005	1,266,426	4,799,082
Total	348,297	561,973	644,133	464,873	554,321	1,005,278	1,280,138	4,859,013
King, or spring:								
½-pound flat	95	14	62		54	67	5,151	5,443
1-pound tall	30,748	43,410	23,667	48,034	40,167	45,451	38,166	269,643
Total	30,843	43,424	23,729	48,034	40,221	45,518	43,317	275,086
Red, or sockeye:								
½-pound flat	24,771	22,692	10,909	8,193	22,320	13,601	28,024	130,510
1-pound flat	36,763	29,821	26,950	85,193	39,941	4,967	16,242	239,877
1-pound tall	1,414,426	1,242,600	1,613,911	1,611,916	1,388,006	1,296,750	1,856,089	10,423,698
Total	1,475,960	1,295,113	1,651,770	1,705,302	1,450,267	1,315,318	1,900,355	10,794,085
Grand total	2,219,047	2,169,872	2,606,973	2,395,477	2,413,053	2,823,817	4,054,641	18,682,880

[a] The ½-pound cases have been reduced one-half in number so as to equal the 1-pound cases in weight.

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND TALL CANS OF SALMON, 1905–1912.

Products.	1905	1906	1907	1908	1909	1910	1911	1912
Coho, or silver	$3.20	$3.63	$3.91	$3.98	$4.07	$4.89	$5.67	$4.44
Dog, or chum	2.69	2.87	2.97	2.53	2.28	3.04	3.72	2.37
Humpback, or pink	2.95	3.00	3.16	2.69	2.40	3.15	3.94	2.55
King, or spring	3.28	3.78	4.18	4.20	4.32	5.34	6.48	5.37
Red, or sockeye	3.38	3.77	4.59	4.52	4.53	5.30	6.33	5.45

MILD CURING.

INVESTMENT IN THE SALMON MILD-CURING INDUSTRY IN 1912.

Items.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Fixed plants	15	$125,000					15	$125,000
Vessels:								
Steamers and launches over 5 tons	41	133,180	2	$10,000			43	143,180
Tonnage	429		40				469	
Launches under 5 tons	10	11,242	1	300	1	$500	12	12,042
Sailing vessels	1	2,000					1	2,000
Boats, row	403	12,490	5	115	3	75	411	12,670
Lighters and scows	4	375					4	375
Gear:								
Haul seines	4	1,850					4	1,850
Fathoms	265						265	
Purse seines	2	1,400					2	1,400
Fathoms	300						300	
Gill nets	169	25,680	20	800	6	300	195	26,780
Fathoms	25,700		1,000		300		27,000	
Hand lines	840	855					840	855
Total		314,072		11,215		875		326,152

Persons Engaged in the Salmon Mild-Curing Industry in 1912.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Fishermen:				
White	386	4	3	393
Indians	245	6		251
Shoresmen:				
Whites	62	2	3	67
Indians	10		6	16
Transporters:				
Whites	48	4		52
Indians				
Total	751	16	12	779

Products of the Salmon Mild-Curing Industry in 1912.

Species.	Pounds.	Value.	Species.	Pounds.	Value.
Southeast Alaska:			Total:		
King salmon	3,961,387	$380,822	King salmon	4,093,370	$395,067
Coho salmon	102,473	4,785	Coho salmon	102,473	4,785
Total	4,063,860	385,607	Grand total	4,195,843	399,852
Central Alaska: King salmon	75,983	7,245			
Western Alaska: King salmon	56,000	7,000			

PICKLING.

Investment in the Salmon-Pickling Industry in 1912.

Items.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Salteries	12		9		5		26	
Value of plants		$19,210		$37,500		$76,800		$133,510
Working capital		4,900		42,200		57,400		104,500
Vessels:								
Steamers and launches over 5 tons	5	13,400	5	29,100	4	16,500	14	59,000
Net tonnage	87		88		40		215	
Launches under 5 tons	8	6,050	5	6,300	2	3,125	15	15,475
Sailing	1	1,000	1	8,000	4	27,000	6	36,000
Net tonnage	33		399		1,354		1,786	
Boats, sail and row	28	925	34	1,535	38	5,150	100	7,610
Lighters and scows	5	1,200	3	1,000	14	4,135	22	6,335
Pile drivers	1	250			2	1,700	3	1,950
Gear:								
Haul seines	12	1,240	30	3,145			42	4,385
Fathoms	1,010		2,420				3,430	
Purse seines	8	2,850	2	300	1	1,000	11	4,150
Fathoms	960		150		175		1,285	
Gill nets	16	1,585	42	3,605	33	3,775	91	8,965
Fathoms	2,055		3,250		4,490		9,795	
Traps:								
Driven			1	500	3	3,000	4	3,500
Floating	1	2,000					1	2,000
Trawl lines	13	150					13	150
Fathoms	4,250						4,250	
Dip nets			2	10	2	25	4	35
Total		54,760		133,195		199,610		387,565

PERSONS ENGAGED IN THE SALMON-PICKLING INDUSTRY IN 1912.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Fishermen:				
Whites	36	34	57	127
Natives	5	136	19	160
Total	41	170	76	287
Shoresmen:				
Whites	31	50	64	145
Natives	9	42	26	77
Japanese	8		3	11
Total	48	92	93	233
Transporters:				
Whites		10	3	13
Natives		5		5
Total		15	3	18
Grand total	89	277	172	538

BARRELS[a] OF SALMON PICKLED IN 1912, BY SPECIES.

Products.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Coho, or silver	274	$2,406	622	$5,007	269	$2,152	1,165	$9,565
Dog, or chum	25	157	1	7	67	488	93	652
Humpback, or pink	3,681	24,419	524	3,668	31	217	4,236	28,304
Humpback bellies	31	534	6	72			37	606
King, or spring	52	208	16	152	157	2,082	225	2,442
Red, or sockeye	252	2,582	6,539	54,195	22,092	208,188	28,883	264,965
Total	4,315	30,306	7,708	63,101	22,616	213,127	34,639	306,534

[a] Barrels holding 200 pounds of fish.

FRESH FISH.

Shipped from Alaska.—The fresh-salmon industry of southeast Alaska has assumed quite extensive proportions since 1905, when it first developed on a scale of any importance. Shipments are made by way of the regular steamship lines from Juneau, Petersburg, Wrangell, and Ketchikan. The fish are eviscerated and are packed in crushed ice in boxes holding on the average about 450 pounds. Shipments are made at all seasons of the year, and all species of salmon are handled. The greatly increased demand for kings for mild-cure purposes has very materially diminished shipments in a fresh state. A greatly increased number of dog salmon were shipped fresh during 1912. There was also a distinct gain in shipments of humpback salmon.

Shipments of fresh salmon from Alaska in 1912 totaled 1,188,923 pounds, valued at $87,463. This was a falling off of 736,649 pounds, valued at $21,459, from 1911.

Marketed locally in Alaska.—The local consumption of fresh fish has assumed quite extensive proportions in Alaska. The chief distributing point in this trade is at Juneau. So far as figures are

available, it is shown that about 50 per cent of the fresh fish marketed locally is halibut, approximately 35 per cent salmon, principally of the king, coho, and sockeye species, and about 15 per cent is black cod, and in a small way a few miscellaneous fishes. Local prices for halibut and black cod run about 7 cents per pound, while salmon bring from 10 to 12 cents. The total quantity marketed is approximately 250,000 pounds of halibut, valued at $18,000; 150,000 pounds of salmon, worth $14,000; and 100,000 pounds of cod and miscellaneous species, valued at $8,000; or a total of 500,000 pounds, worth $40,000.

Freezing.—There were four plants in southeast Alaska this year where salmon were frozen. These were the shore stations of the Taku Canning & Cold Storage Co. at Taku Harbor, J. Lindenberger (Inc.) at Craig, and the New England Fish Co., at Ketchikan; and the floating cannery and cold-storage ship, *William H. Smith*, operated by the Weiding & Independent Fisheries Co., at Saginaw Bay.

SALMON FROZEN IN ALASKA IN 1912.

Species.	Pounds.	Value.
Coho salmon	214,175	$11,675
Dog salmon	230,798	8,006
King salmon	6,070	606
Total	451,043	20,287

MINOR PRESERVING PROCESSES.

Special products.—The Revilla Reduction Works, established at Ketchikan late in 1910 for the purpose of preparing oil from shark and dogfish livers, suspended operations after one season because of a shortage of raw material, and in 1912 under the name of the Revilla Fish Products Co. began operations as a cannery for the preparation chiefly of special fishery products. The company also engaged in the canning of red salmon. The special products included (1) fish pudding; (2) smoked salmon loaf, made principally from mild-cured king salmon; (3) smoked fish loaf, of which cod and halibut are the chief base; (4) deviled halibut; and (5) canned halibut. Cereals, oils, and spices are used in the preparation of the first four items, and in each case the finished product is both palatable and thoroughly wholesome. This company is the first to engage in the preparation of these products. During 1912, the first season, the output included 1,925[a] cases of fish pudding, valued at $11,550; 2,157[b] cases of smoked salmon loaf, valued at $8,628; and 1,135[b] cases of smoked fish loaf, valued at $4,540. The output of canned

[a] Each case represents forty-eight 1-pound flat cans.

[b] Each case represents forty-eight ½-pound flat cans.

salmon and halibut is included in tables appearing elsewhere in this report.

Beleke.—For a number of years past it has been the custom to prepare at Kodiak and in a lesser way at other places a very palatable product known locally as beleke. This was made from the backs of red and coho salmon the bellies of which were salted. The preparation of beleke was suspended this season chiefly by reason of the establishment of a cannery at Kodiak.

Salmon bellies and ukalu.—It is noteworthy that practically no salmon bellies were put up in Alaska this year. The law requires that the remaining edible portion of the fish shall be utilized to avoid wanton waste, and as this is not always easy of accomplishment at a profit and involves considerable labor, the incentive to prepare salmon bellies is much lessened. It is a common practice to dry the backs of the fish thus used, and the resulting product, designated as ukalu, is used as dog food, also for fox food at the fox ranches. The market for ukalu is entirely local.

Kippered salmon.—A most delicious product, designated as kippered salmon, is put up in a moderate way on the Pacific coast. It is prepared by lightly smoking mild-cured king salmon, often of the white-meated variety. The very attractive quality of this product merits a wider market and an extension of the industry to Alaska.

HERRING FISHERY.

GENERAL CONDITIONS.

The herring is an incredibly numerous fish that is found in the waters of Alaska at all seasons of the year, but more particularly during the winter and spring months. The rôle played by the herring is of diversified character. It is a valuable food fish, the Orient being the chief market at present for the Alaska product; it is the making of the halibut fishery on account of its use for bait; it is utilized extensively in the manufacture of fertilizer and oil, a practice that probably will be discontinued by legal mandate in a few years, and the herring also is consumed in enormous quantities by other fishes.

At first thought it might seem that these heavy drains would soon diminish the supply of herring almost to the point of extermination, but such is not the case. The history of the herring fishery the world over, and particularly of northern Europe where it has been prosecuted vigorously for generations, demonstrates the fallacy of the claim made by some that there has been a constant and appreciable decline in the supply of herring. There are occasional instances of the more or less temporary disappearance of the large runs, as for example, at Nanaimo, British Columbia, where a few years ago enormous quantities of herring were taken by Japanese fishermen

and the fish seemed to disappear almost entirely for a time. It is now reported that the run has again resumed heavy proportions. Whether the temporary diminution was caused by heavy catches or whether it resulted from the generally recognized natural tendency to cycles in the runs of fish, showing lean as well as full periods or years, can not be answered definitely. But in the light of past experience, it would seem safe to ascribe conditions in the Nanaimo region more especially to the latter cause.

In Alaska it is said by some that herring are no longer as numerous as they were a decade ago, and the absence of large runs from Gastineaux Channel is cited in support of this contention. Undoubtedly it is true that Gastineaux Channel has shown but comparatively limited numbers of herring during the last few years, but this is not heard with reference to Auk Bay or other near-by waters well known for herring. It may be reasoned that the cycle theory—the periodic preference shown by fish for certain waters—is the chief cause of present conditions in Gastineaux Channel. It is said by an old-time resident of the region that from 1885 to 1890 there were almost no herring in Gastineaux Channel, while for a few years thereafter the runs were moderately good, and in 1901 and 1902 they appeared in large numbers. Since that time an occasional school has been seen. It should be noted that at no time has this body of water been recognized as a regularly heavy producer of herring. For 25 years or more there has been a deposit of stamp-mill tailings in Gastineaux Channel, but the quantity of detritus therefrom which is not dispersed by tidal action is so limited, relatively speaking, that it scarcely can have had much effect upon the runs of herring, at least up to the present time.

There is need of regulation and the prevention of wasteful practices in the herring fishery even as in the case of the salmon fishery, notwithstanding that the runs of herring are heavy and that their prolific breeding habits make the danger of depletion less imminent. In this connection, citation is made of the doubtful practice of the Indians at Auk Bay and other places of putting brush in the water each spring during the spawning season for the purpose of securing herring eggs which they dry and make use of as a food delicacy. The adhesive tendency of herring eggs makes it an easy matter to thus secure large quantities with but comparatively little effort. Countless millions of eggs are in this manner destroyed by the Indians. It is doubtful whether this practice of the Indians should longer be permitted.

The herring industry is confined largely to the southeastern part of Alaska, though of late considerable activity has developed to the westward in the region of the Shumagin Islands. In the southeastern section the work has centered at Juneau, Killisnoo, Petersburg, and Ketchikan. At Juneau and Petersburg it is chiefly for

bait purposes that herring are handled; at Killisnoo there is a plant for the manufacture of fertilizer and oil from herring; while at Ketchikan large numbers of herring are handled during the winter for the Oriental export trade. Also at Ketchikan the New England Fish Co. freezes a large quantity of herring for halibut bait. The heaviest catches of herring are made in the Behm Canal region, particularly in Yes Bay and Spacious Bay. A new plant for handling herring was erected this season on the latter body of water. Though nominally an American organization, this was largely controlled and operated by Japanese. Another company used the barge *America* in these waters for herring operations. In this region the herring are caught by means of purse seines. In central Alaska several hundred barrels of herring were salted at shore stations on Simeonof Island, operated by Ross Boye and by the Union Fish Co. Herring are taken in this region by means of gill nets.

Much difficulty has been experienced in utilizing herring during the summer months when they are filled with the so-called "red feed," a small crustacean which causes rapid decomposition once the fish is removed from the water. Even the use of salt will not entirely arrest this deleterious influence. Capt. A. W. Thomas, of Ketchikan, who conducted bait herring operations at Port Walter, tried the plan of holding herring alive for a time in several inclosures. At the end of three days the objectionable "red feed" had entirely digested and the herring were in good condition for bait or food purposes. An extension of this idea will work a distinct benefit to the herring industry.

The popular agitation against the use of herring for fertilizer and oil still continues. The chief objection comes from the halibut fishermen who claim that their supply of bait is endangered. This contention is open to serious question, yet it possesses some merit and at the same time is a distinct majority plea. Under these circumstances and for other reasons it appears no more than proper that after allowing present operatives from 5 to 10 years in which to bring their business to a close it should be made unlawful to use food fish, other than the waste portions thereof from canneries or similar establishments, in the manufacture of fertilizer or oil.

It is interesting to note, however, that in the manufacture of fish fertilizer the product is applied to the soils, and thereby crops are greatly improved. From this point of view it may be said that the herring thus converted are after all utilized as food products, though in an indirect way.

The Alaska herring is marketed but little except in Pacific coast regions. It is said by the trade that present freight rates prohibit its exploitation in farther distant sections. Most of the product is now sold in the Orient, but difficulties in the way of satisfactory transportation arrangements have retarded the development of this almost unlimited field.

STATISTICAL SUMMARY.

The statistics show a very substantial development of the Alaska herring fishery during 1912. There was an increase of 27 per cent in the number of persons engaged, an increase of 14 per cent in the investment, and a gain of 18 per cent in production.

The total investment in the herring fishery in Alaska in 1912 was $338,890, of which $336,860 was in southeast Alaska and $2,030 in central Alaska. This is an increase over the investment of the previous year in southeast Alaska of $50,940 and a decrease for central Alaska of $7,270, or a total increase of $43,670.

There were 339 persons employed this year, a gain of 74 over 1911. A noteworthy feature is the increase in the number of Japanese from 33 in 1911 to 52 in 1912.

The total value of the products amounted to $239,278, a gain of $37,369 over 1911. There were notable increases in the preparation of herring for both food and bait purposes, but there was a marked decline in the use of herring in the manufacture of fertilizer and oil.

INVESTMENT IN THE HERRING FISHERY IN ALASKA IN 1912.

Items.	Southeast Alaska.		Central Alaska.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Fishing vessels:						
Steamers and launches	11	$48,800			11	$48,800
Tonnage	194				194	
Sailing	1	20,000			1	20,000
Tonnage	1,939				1,939	
Launches under 5 tons	19	17,500			19	17,500
Boats, sail and row	50	2,760	4	$400	54	3,160
Scows	13	7,300			13	7,300
Pile drivers	2	1,200			2	1,200
Apparatus:						
Haul seines	2	600	2	1,000	[a] 4	1,600
Purse seines	26	17,200			[b] 26	17,200
Gill nets			12	630	[c] 12	630
Traps, stake	1	1,000			1	1,000
Cash capital		110,500				110,500
Shore and accessory property		110,000				110,000
Total		336,860		2,030		338,890

[a] Aggregate length of 1,500 yards. [b] Aggregate length of 9,580 yards. [c] Aggregate length of 1,700 yards.

PERSONS ENGAGED IN THE ALASKA HERRING FISHERIES IN 1912.

Occupations and races.	Southeast Alaska.	Central Alaska.	Total.
Fishermen:			
Whites	112	8	120
Indians	20		20
Japanese	30		30
	162	8	170
Shoresmen:			
Whites	131		131
Indians	14		14
Japanese	22		22
	167		167
Transporters: Whites	2		2
Grand total	331	8	339

PRODUCTS OF THE ALASKA HERRING FISHERIES IN 1912.

Products.	Southeast Alaska.		Central Alaska.		Total.	
	Quantity.	*Value.*	*Quantity.*	*Value.*	*Quantity.*	*Value.*
Herring:						
Fresh, for food.....pounds..	4,041,000	$40,740	.....	.....	4,041,000	$40,740
Fresh, for bait.....do....	3,624,000	27,075	.....	.....	3,624,000	27,075
Frozen, for food.....do....	13,550	150	.....	.....	13,550	150
Frozen, for bait.....do....	700,000	7,500	40,000	$400	740,000	7,900
Pickled, for food.....barrels..	3,253	22,570	604	4,896	3,857	27,466
Pickled, for bait.....do....	2,270	4,600	.....	.....	2,270	4,600
Dry-salted, for food.....pounds..	4,204,846	40,947	.....	.....	4,204,846	40,947
Fertilizer.....do....	2,580,000	38,700	.....	.....	2,580,000	38,700
Oil.....gallons..	235,000	51,700	.....	.....	235,000	51,700
Total.....	.....	233,982	.....	5,296	15,444,523	239,278

HALIBUT FISHERY.

GENERAL CONDITIONS.

The halibut fishery of Alaska has been of gradual growth, but had already assumed large proportions before any regular statistics were compiled, owing to lack of facilities in the Bureau. It is, moreover, a baffling subject for statistical report, because it is conducted in connection with the halibut fishery of the Pacific States in such a way that accurately to separate investment and number of men employed is not feasible. Furthermore, many men in Alaska fish for halibut during part of the year, for salmon during another part, and perhaps follow other occupations at other times. Statistical tables for the Alaska halibut fishery must therefore be interpreted with allowance for this factor of error.

The fishery divides itself essentially into two branches, one conducted in inland protected waters, the other at sea. The former is carried on by small vessels, largely owned in Alaskan territory, and by vessels out of Puget Sound ports, the catch not landed at any point in Alaska.

The sea fishery for halibut is prosecuted in extra territorial waters, that is, outside the 3-mile limit and adjacent to British as well as American jurisdiction. Part of this catch is landed at Alaskan points and shipped on regular steamers; another part is taken directly to Vancouver or Puget Sound points.

The season of the halibut fishery in Alaska is chiefly the period from September until May, though in recent years a number of vessels have fished continuously throughout the year for the freezing plants of southeast Alaska. Most of the winter catch is shipped fresh to Puget Sound ports for delivery thence to eastern markets.

The power schooners comprising most of the halibut fleet come principally from Puget Sound. They arrive in September and stay through the winter. Until recently, Frederick Sound, Icy Strait, and other inshore waters have been good halibut grounds, but now catches are very largely from outside waters. Trawls are set at depths varying all the way from 10 to 300 fathoms.

The fact that most of the halibut are now caught farther offshore has resulted in a decline in the small power boat fishery. Reference is had in particular to the considerable number of small craft under 5 tons manned by Indians and others that fished the more protected inshore waters. Larger boats with more extensive equipment are needed for open-sea fishing.

The floating warehouses which have been used at Scow Bay for handling catches of halibut were last winter moved to Petersburg. This place is several miles nearer the fishing grounds and is a convenient point for shipment by way of the regular steamship lines. It is also convenient by reason of its accessibility to an almost unlimited supply of glacier ice, free for the taking. This feature has likewise helped to make Juneau a popular halibut center. At Ketchikan artificial ice has been available at nominal cost, and since no time is lost in handling, is probably as cheap in the long run as ice from the glaciers.

The strike of halibut fishermen on the steamers, also a succession of storms which kept the smaller craft in port much of the time, greatly lessened the receipts of halibut during November and December. A great increase in price resulted, as much as 10 cents per pound being paid for some fares before the end of the year. The effort to man the steamers with fishermen imported from the East did not prove successful.

The lack of bait has at times been a serious problem in the halibut industry. The solution seems to lie in freezing a sufficient quantity during the winter months when herring are plentiful to last throughout the season. Frozen bait is as good in every way as fresh bait. The use of salt bait has never been satisfactory.

The schooner *Metha Nelson* (399 tons) was operated again this year, in the vicinity of Kodiak Island, as a floating cold-storage plant. Although the eruption of Mount Katmai on June 6 interfered with the work, a good catch of halibut was frozen for delivery at San Francisco. During the summer the Weiding and Independent Fisheries Co. operated the ship *William H. Smith* in southeast Alaska as a combination floating cannery and cold-storage plant. In addition to canning salmon, both halibut and salmon were frozen. The Taku Canning & Cold Storage Co., located at Taku Harbor, engaged in freezing halibut in addition to its principal business of canning salmon. This concern has two sharp freezers and storage capacity for about half a million pounds of halibut.

The Revilla Fish Products Co. was engaged at Ketchikan for the first time this year in the canning of special fishery products, among which was an attractive article designated as deviled halibut. This was made from halibut, cereals, and other materials. The company also put up a few cases of canned halibut, as well as salmon products, the latter being shown elsewhere in this report.

During the spring of 1912 the cold-storage plant of the New England Fish Co. at Ketchikan was increased to nearly four times the capacity of the original plant built in 1908. The total capacity is now 6,000,000 pounds, and there are facilities for handling 100,000 pounds daily. This is one of the largest plants in the country devoted exclusively to freezing fish.

The process of freezing halibut in Alaska is conducted in a manner which insures a very high-grade product. The fish are brought in carefully packed in ice. They have been eviscerated aboard the vessel at the fishing grounds the same day of their capture. As soon as landed they are beheaded, weighed, and thoroughly washed, to go immediately to the sharp freezers, where they are placed on trays and frozen hard for 24 hours in a temperature of from 10° to 20° F. They are then dipped in fresh water four or five times, giving a glazing or coating of ice about one-sixteenth inch thick. The temperature of this room is held approximately at 12° F., as are also the storage rooms, where the fish are stacked up like cordwood to be held awaiting shipment.

Preparatory to shipment, the fins are trimmed off and the fish are reglazed by one dipping chiefly for the purpose of covering the cuts made in the trimming process. After this each fish is wrapped separately in a sheet of vegetable parchment, around which is put a sheet of smooth finish manila wrapping paper. The fish are then placed in substantial boxes of about 370 pounds capacity. These boxes are lined with the same kind of paper used as the outside wrapping for each fish.

The boxes are then put aboard steamers and placed in cold storage compartments. Upon arrival at Seattle, or other terminal, some three or four days later, they are loaded into refrigerator cars previously cooled for 24 to 36 hours, and are dispatched at once to the distributing centers, chiefly in the larger eastern cities, and particularly in the New England States.

As thus handled the frozen halibut from Alaska are thoroughly wholesome, and with the careful methods now usually followed by the distributing agents and retailers a first-class food product is assured the consumer.

STATISTICAL SUMMARY.

The statistical tables for Alaska heretofore published have not included certain steamers nor their catch from Alaska waters landed for convenience at Vancouver or Seattle. There has also in the past been a segregation of operations into a vessel catch and a shore catch. These features have been modified in the present report to include all vessels fishing Alaska waters, and no differentiation is now made between the so-called vessel and shore catches.

The total investment this year amounted to $2,036,050. The gain from the investment of $1,194,000 in 1911 is due chiefly to the addition of figures formerly omitted for vessels landing their catch without passing through Alaska ports. An increase has been noted in the valuation of shore and accessory property.

The total number of persons engaged in the Alaska halibut fisheries in 1912 was 1,038. The figures for 1911 show 651 persons, but those engaged on steamers and in part the so-called Puget Sound fleet operating in Alaska waters, were omitted. It is safe to say, however, that there was a considerable increase in the number of persons engaged, owing to the construction of a new steamer and the addition of quite a number of schooners to the fleet.

In 1911 the prepared weight of the catch in Alaska waters was 19,714,950 pounds, valued at $940,858. This includes the catch of the Puget Sound fleet, with the exception of the steamers. In 1912 the total production was 16,896,743 pounds (inclusive of the steamer catch), valued at $927,502. Although there was a material decline in quantity, the total value in 1912 was nearly the same as that of 1911. The price in 1911 averaged 4.7 cents per pound, while in 1912 it was 5.4 cents, an advance of seven-tenths cent per pound.

The decline in production may be ascribed to the fishermen's strike near the close of the year for an increase of from 1 to 1½ cents per pound; also weather conditions were unfavorable to a large catch during 1912. In addition, it is recognized that the banks are becoming depleted. This means that operations must be carried farther afield each season in an effort to locate new grounds. No doubt another season or so will see a considerable invasion of the hitherto little known and unexploited banks of central Alaska.

INVESTMENT IN THE ALASKA HALIBUT FISHERIES IN 1912.

Items.	Southeast Alaska.		Central Alaska.		Total.	
Fishing vessels:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Steamers and power vessels	105	$1,163,000	1	$7,500	106	$1,170,500
Tonnage	2,598		40		3,038	
Outfit		453,000		1,000		454,000
Boats, dories	345	17,250	2	100	347	17,350
Apparatus: Trawls and fishing gear		69,000		200		68,200
Shore and accessory property		325,000				325,000
Total		2,027,250		8,800		2,036,050

PERSONS ENGAGED IN THE ALASKA HALIBUT FISHERIES IN 1912.

Races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Whites	1,014	4		1,018
Natives	12	8		20
Total	1,026	12		1,038

PRODUCTS OF THE ALASKA HALIBUT FISHERIES IN 1912.

Products.	Southeast Alaska.		Central Alaska.		Total.	
	Pounds.[a]	*Value.*	*Pounds.*[a]	*Value.*	*Pounds.*[a]	*Value.*
Halibut:						
Fresh	13,351,306	$696,731			13,351,306	$696,731
Frozen	3,281,190	212,066	140,415	$7,722	3,421,605	219,788
Fletched	72,776	3,638			72,776	3,638
Dry salted	10,000	500			10,000	500
Smoked	400	120			400	120
Deviled	[b] 39,840	6,640			39,840	6,640
Canned	[c] 816	85			816	85
Total	16,756,328	919,780	140,415	7,722	16,896,743	927,502

[a] Prepared weight.
[b] Represents 1,660 cases, each containing 48 ½-pound flat cans.
[c] Represents 17 cases, each containing 48 1-pound flat cans.

STATISTICS OF ALASKA HALIBUT FISHERIES, 1905–1012.

Years.	Fishery in Alaska territory.			Vessel fishery in extraterritorial waters.[a]			
	Men employed.	Investment.	Pounds of halibut.	Men.	Vessels.	Investment.	Pounds of halibut.
1905	276	$95,980	4,675,900				
1906	304	106,702	4,245,644	128	23	$55,645	[b] $2,002,670
1907	591	164,126	4,487,618	159	30	64,050	2,640,489
1908	395	340,825	5,662,006	166	25	56,730	1,527,674
1909	281	340,032	5,189,924				2,259,529
1910	829	1,258,004	21,630,289	1,800	60	852,080	4,414,555
1911	651	1,194,073	[b] 17,315,571				[b] 2,399,379
1912	1,038	2,036,050	[c] 16,896,743				

[a] A number of steamers from Puget Sound in addition; catch not known.
[b] Dressed or prepared weights.
[c] Inclusive of the steamer catch.

COD FISHERY.

GENERAL CONDITIONS.

The commercial fishery of Alaska other than whaling had its real inception in the operations of cod fishermen. This work dates back almost to the middle of the last century when schooners were dispatched from San Francisco and returned with fares of cod from Alaska, equal or even superior in quality to the well-known cod of the eastern coast. From the early sixties to the present day Alaska has constantly maintained a prominent position in meeting the demand for this staple food fish. The cod fishery is now fourth in relative importance of the fisheries of Alaska, being exceeded by the salmon, halibut, and herring operations, unless account be taken also of the unusual spurt shown by the whale fishery this year.

Cod operations in Alaska are conducted almost exclusively by firms having their headquarters in Washington and California. The three San Francisco companies have a number of shore stations at

the Shumagin and Sannak groups of islands. These are supplied by dory fishermen, and when a sufficient accumulation is made the catch is sent to the States on sailing vessels. Five of these transporting vessels were engaged during 1912. The Puget Sound companies obtain their catch entirely by means of offshore vessel operations. The Pacific Coast Codfish Co.'s schooner operated in the vicinity of the Shumagins, and the two vessels of the Matheson Fisheries Co. fished entirely in Bering Sea.

The Western Codfish Co., with headquarters at Seattle, discontinued operations at the conclusion of the 1911 season. The schooners *Maid of Orleans* and *Vega*, which this company sent north in 1911, were operated this year by the Matheson Fisheries Co., of Anacortes, Wash., and the Union Fish Co., of San Francisco, respectively. Headquarters of the Blom Codfish Co., formerly at Tacoma, have been transferred to the Seattle office of the Kildall Fishing & Packing Co.

Operations in Alaska this year were not of a particularly satisfactory character. The catch was much curtailed on account of inclement weather when it was impossible to fish. Casualties were unusually heavy, no less than eight fishermen being lost. In addition, the mate of the schooner *Joseph Russ* lost his life when that vessel was wrecked on Chirikof Island, April 21, 1912, while en route northward to begin the season's work. This schooner was operated by the Robinson Fisheries Co., of Anacortes, Wash.

Considerable attention was devoted to the preparation of stockfish, which is a hard dried form of codfish. This work was carried on by Messrs. John H. Nelson and R. H. Johnson, who have shore stations at Squaw Harbor, on Unga Island. This feature of the work is conducted during the colder part of the year. Stockfish are generally shipped in bales.

SHORE STATIONS.

Shore stations were situated as follows: Alaska Codfish Co.: Unga, Baralof (Squaw Harbor), and Kellys Rock (Winchester), on Unga Island; Companys Harbor and Moffats Cove, on Sannak Island; and Dora Harbor, on Unimak Island. John H. Nelson: Squaw Harbor, Unga Island. R. H. Johnson: Squaw Harbor, Unga Island. Pacific States Trading Co.: Northwest Harbor, Little Koniuji Island. Union Fish Co.: Pirate Cove, Popof Island; Northwest Harbor, Little Koniuji Island; Pavlof Harbor and Johnson Harbor, on Sannak Island; Sanborn Harbor, on Nagai Island; Simeonof Harbor, Simeonof Island; and Unga, on Unga Island.

ALASKA CODFISH FLEET, 1912.

The following fleet of sailing vessels from California and Puget Sound engaged in Alaska codfish operations this year:

Names.	Class.	Net tonnage.	Operators.
Fanny Dutard	Schooner	252	Matheson Fisheries Co., Anacortes, Wash.
Maid of Orleans	do	171	Do.
Alice	do	220	Robinson Fisheries Co., Anacortes, Wash.
Joseph Russ [a]	do	235	Do.
Fortuna	do	138	Blom Codfish Co., Seattle, Wash.
John A	do	235	Pacific Coast Codfish Co., Seattle, Wash.
Vega [b]	do	233	Union Fish Co., San Francisco, Cal.
Sequoia [b]	do	324	Do.
Galilee [b]	Brigantine	328	Do.
W. H. Dimond	Schooner	376	Alaska Codfish Co., San Francisco, Cal.
John D. Spreckels [b]	do	253	Do.
City of Papeete	Barkentine	370	Do.
Ottilie Fjord	Schooner	247	Pacific States Trading Co., San Francisco, Cal.
Bertha Dolbeer [b]	do	230	Do.

[a] Wrecked Apr. 21, 1912. [b] Transporting vessels.

The statistics relating to the foregoing vessels are included in the tables. Heretofore figures for vessels have in part been omitted.

STATISTICAL SUMMARY.

The total investment in the cod fishery in Alaska in 1912 was $274,674, as against $215,670 in the previous year. The number of persons engaged was 485 (347 fishermen, 83 shoremen, and 55 transporters), as against 284 in 1911.

Practically the same number of persons were engaged this year as last. The apparent increase from 284 in 1911 to 485 in 1912 results from the fact that the vessel fishermen and employees are now included in the statistical tables, which was not previously done.

The catch totaled 8,064,853 pounds of prepared products, valued at $218,268. This includes both vessel and shore station catch. The combined figures from these two sources in 1911 amounted to 11,305,288 pounds, cured weight, valued at $330,030. It will thus be noted that 1912 shows a decrease of about 35 per cent as compared with 1911. Stormy weather and the loss of one of the fishing vessels had much to do with the decline.

INVESTMENT IN THE COD FISHERY IN ALASKA IN 1912.

Items.	Number.	Value.	Items.	Number.	Value.
Transporting vessels:			Boats, row	360	$10,920
Steamers and launches	3	$21,000	Apparatus:		
Tonnage	78		Hand lines		3,004
Outfit		3,500	Trawl lines		150
Launches under 5 tons	2	2,600	Cash capital		50,000
Sailing vessels	5	44,000	Shore stations and accessory property		66,500
Tonnage	1,368				
Fishing vessels	[a] 11	73,000			
Tonnage	2,285		Total		274,674

[a] Includes 2 small sailing vessels used locally; tonnage, 31.

There were 485 persons engaged in cod fishery operations in central Alaska during 1912.

PRODUCTS OF ALASKA COD FISHERIES IN 1912.

Products.	Prepared weight.	Value.
	Pounds.	
Salted	8,017,903	$215,728
Pickled	900	60
Tongues, pickled	9,100	682
Stock fish	36,950	1,798
Total	8,064,853	218,268

WHALE FISHERY.

GENERAL CONDITIONS.

Unusual activity marked the shore-station whaling industry in Alaska waters this year. In addition to the Tyee Co., which has operated several seasons, the Alaska Whaling Co. and the United States Whaling Co. entered the field in extensive manner. A general discussion of the work of each company will be given below.

Unfavorable weather conditions, which much of the time made it impossible to hunt, also the failure to take a better proportion of the more valuable sperm and sulphur-bottom varieties, resulted in an unsatisfactory season. Moreover, the market for the finished product was not as strong as anticipated. In order to put the business on a better basis, arrangements ought to be made to utilize every portion of each whale killed instead of only the oil and bone, as is chiefly the case in Alaska at present.

TYEE CO.

The Tyee Co. operated only one killing boat this year, the *Tyee Junior* (71 tons). The hunting was farther offshore, attention being directed almost wholly to the capture of the larger whales—sperms and sulphur bottoms—which are much more profitable to handle. In addition to the *Tyee Junior*, the fleet consisted of the schooner *Allen A* (266 tons) and the unrigged vessels *Diamond Head* (952 tons) and *Fresno* (1,149 tons). The barge *Sperm* was also utilized.

The company's shore station at Tyee near the lower end of Admiralty Island was not in use this season, the work being carried on instead at Whale Bay on the southwest shore of Baranof Island. All of the processing and work was done on the barges anchored in Whale Bay, where the whales were towed by the *Tyee Junior*. The change of base from Tyee was much more satisfactory by reason of the new location being nearer the whaling grounds.

The first whale was killed April 20 and the last September 22. One sperm and one sulphur bottom were lost during September on account of rough weather. The Tyee Co. operated for oil and bone fertilizer. No attempt was made this year to utilize other portions of the carcass, as in previous seasons.

ALASKA WHALING CO.

The Alaska Whaling Co., an organization incorporated under the laws of the State of Minnesota, operated for the first time in Alaska this season. A station was established at Akutan Harbor, on the northern shore of Akutan Island. The latter part of May the Norwegian steamer *Admiralen* (998 tons) arrived from Sandefjord, Norway, with a cargo consisting principally of metal tanks and material for the shore station, and cannon, harpoons, lines, and other equipment for the two killing steamers *Unimak* and *Kodiak* (each of 99 tons), which vessels were built at Seattle early in 1912. The *Admiralen* was equipped as a floating factory for the conversion of blubber into crude oil.

Whaling operations were begun June 3 and continued until October 21. The total take was 310 whales, of which 174 were males and 136 females. The shore station was not ready until the first of July, until which time the blubber only was utilized aboard the *Admiralen*. At the shore station both oil and fertilizer were prepared.

Unfavorable weather also interfered with the operations of this company, lessening the catch materially. The bark *Hadyn Brown*, under charter to the company, was wrecked May 12, 1912, on Montague Island, and seven lives were lost. The vessel was returning light in tow of the tug *Pioneer*, but during a severe gale it was necessary to cut adrift and the disaster followed.

UNITED STATES WHALING CO.

Another new concern to engage in whaling operations in Alaska was the United States Whaling Co., incorporated under the laws of South Dakota. A shore station was erected at Port Armstrong, on the southeast shore of Baranof Island; also the Norwegian steamer *Sommerstadt* (2,777 tons) was employed as a floating factory. The material for the shore station and the equipment of the three American-built whaling vessels used by the company arrived from Norway on the *Sommerstadt* about the middle of April. Three steam whaling vessels were built for the company during the past winter at Seattle. These are the *Star I*, 133 net tons burden, and the *Star II* and *Star III*, each of 97 net tons. A whaling gun is mounted at the bow of each as in the case of similar vessels employed in the same work.

On July 14 the *Sommerstadt*, in company with the *Star II* and the *Star III*, left for Sanborn Harbor, on the west shore of Nagai Island,

and remained in that section until September 17, capturing 9 sulphur bottoms, 144 humpbacks, and 31 finbacks during that time. The reduction process was conducted aboard the *Sommerstadt*. The *Star I* continued to operate in the vicinity of Port Armstrong, delivering the whales to the shore station.

The total number of whales taken by all three vessels for the season was 314, of which 143 were males and 171 females. Operations were begun May 4 and continued until October 8.

The floating boileries *Admiralen* and *Sommerstadt*, employed by the last two above-named companies, remained at anchor in the harbors mentioned, and did not cruise with the American-built whalers on the high seas to treat the carcasses of the whales as fast as taken. The latter course is the usual one, and was the original plan of the two new Alaska companies. A change was necessary, however, to bring the work in conformity with the laws of the United States. Officers of the customs service were stationed aboard the *Admiralen* and *Sommerstadt*, with authority to enter and clear the American-registered vessels used in hunting whales.

SAN FRANCISCO WHALING FLEET.

Operations of the San Francisco fleet in northern waters during 1912 were not of an extensive or satisfactory nature. Of the vessels that went north in the spring, the schooner *Lettitia* (233 tons) arrived October 3 with 245 barrels of sperm oil; the bark *Gay Head* (252 tons) arrived October 24 with 54 barrels of sperm oil; and the bark *John and Winthrop* (321 tons) arrived October 25 with 35 barrels of sperm oil. The steamer *Belvedere* (339 tons), which sailed north in the spring of 1911 and wintered in the Arctic, arrived November 1 with 900 barrels of oil and 32,800 pounds of whalebone, also a shipment of furs. The schooner *Alice Stofen* (17 tons) cleared on a whaling voyage May 16, but had not returned up to the end of the year.

The power schooner *Elvira* (60 tons) arrived November 7 from a cruise in northern waters, during which 12 bowhead whales were captured that produced 17,544 pounds of bone. The schooner *Allen A* (266 tons), which arrived from Alaska November 7, was employed in the interests of the Tyee Co.'s shore whaling operations.

The steamers *Herman* (229 tons) and *Karluk* (247 tons) and the brigantine *Jeanette* (217 tons), which vessels were until recently engaged actively in whaling operations, did not sail this year. The following whaling vessels (steamers) were also laid up during the year: *Beluga* (409 tons), *Bowhead* (243 tons), *Narwhal* (389 tons), and the *Thrasher* (502 tons).

NORWEGIAN VESSELS.

The Norwegian whaling steamer *Kit* (247 tons), which was equipped in the dual capacity of floating factory and killing boat, attracted

considerable attention on Puget Sound early in the season by reason of efforts to get a clearance for a whaling voyage. There is no provision for clearing a vessel of foreign registry from an American port to engage in whaling operations, hence the request was denied. The *Kit* finally cleared for the high seas, and cruised in northern waters, a fair catch of walrus skins, oil, and ivory resulting. No whales were taken.

STATISTICAL SUMMARY.

The total sum invested in the shore-station whaling operations was $1,140,831, the largest ever shown in this industry. The total number of persons engaged, including those employed on the auxiliary vessels, was 302, including 22 Japanese and 12 Indians. The value of the product was $293,295.

In addition, whalebone was produced in western and Arctic Alaska to the extent of 11,317 pounds, valued at $18,012. This whalebone is from the right or bowhead whale and is much more valuable than the ordinary baleen of commerce. The price, however, has been low this year.

The number of whales taken in the shore operations in 1912 by the three important companies was as follows:

WHALES TAKEN IN SHORE OPERATIONS IN 1912.

Companies.	Humpback.	Finback.	Sulphur bottom.	Sperm.	Total.
Alaska Whaling Co	148	162			310
United States Whaling Co	163	72	70	9	314
Tyee Co	4	1	42	14	61
Total	315	235	112	23	685

During the season's operations it has been noted that the average number of barrels of oil per whale, according to species, is as follows: Sperm, 80; sulphur bottom, 78; finback, 30; and humpback, 25. By reason of the quality of oil produced, the sperms are much more valuable in proportion than the other species named.

Figures relating to whaling, other than the shore-station operations, are not included in the statistical tables.

INVESTMENT IN THE WHALE FISHERY IN ALASKA IN 1912.

Items.	Number.	Value	Items.	Number.	Value.
Vessels:			Vessels—Continued.		
Steamers	8	$581,435	Lighters and scows	4	$10,742
Tonnage	4,371		Pile drivers	2	2,000
Launches under 5 tons	2	2,612	Value of plants		515,518
Sailing vessels	3	28,324			
Tonnage	2,367		Total		1,140,831
Boats, row	4	200			

Persons Engaged in the Whale Fishery in Alaska in 1912.

Races.	Persons engaged.
Whites	268
Natives	12
Japanese	22
Total	302

Products of Alaska Shore Whaling Operations in 1912.

Products.	Quantity.	Value.
Whale oil ....gallons..	928,755	$285,500
Fertilizer ....pounds..	356,000	3,285
Whalebone or baleen ....do....	70,417	22,522
Total	....	311,307

FERTILIZER AND OILS.

Operations this year for the manufacture of oil or fertilizer or both from fishery products were conducted by the following: Alaska Oil & Guano Co., Killisnoo; Alaska Whaling Co., Akutan; United States Whaling Co., Port Armstrong; the Tyee Co., operating a floating plant in Whale Bay; W. H. Royden, with a floating plant; and the Union Fish Co., Shumagin Islands. The operations of the first-named company have been shown under the herring fishery, while the three whaling companies appear under the shore-station whale fishery. Mr. W. H. Royden operated the house scow *Elliott* in the region centering at Petersburg, and, in addition to salting salmon, prepared 21 barrels of fish oil, valued at $262. The Union Fish Co. put up 500 gallons of cod oil. This was an experimental undertaking to determine, if possible, whether it might be profitable later to take up the work on a more extensive scale.

MINOR FISHERIES.

TROUT FISHERY.

The trout fishery of Alaska is not of great importance, relatively speaking, notwithstanding the fact that the dolly varden or commonly-called salmon trout abounds. On account of its voracious habits the dolly varden is undoubtedly the most destructive natural enemy that young salmon have in fresh water. The suggestion is frequently heard that the Government ought to place a bounty on trout to aid in preserving the salmon industry. If practicable means could be found, it might be well to adopt this suggestion, for under present conditions trout are far less desirable in Alaska than salmon. This does not apply to the steelhead, for it is an excellent

fish, particularly for freezing, but unfortunately it is not numerous in the waters of Alaska. A total of 26,461 pounds of steelhead trout, valued at $2,645, were frozen during the year, chiefly by the Taku Canning & Cold Storage Co.

Quite a proportion of the pack of the Midnight Sun Packing Co., from Kotzebue Sound waters, was made up of dolly varden trout. The Alaska Packers Association also put up a few cases of this same species. Canned dolly varden trout lack the pinkish or red color demanded by the trade in products of this character from Alaska; also the flesh when canned is not as firm as salmon. There appears to be no immediate prospect of much development in the canning of trout in Alaska.

The following products of the trout fishery were reported during 1912:

PRODUCTS OF THE ALASKA TROUT FISHERY IN 1912.

Sections and species.	Fresh.		Frozen.		Canned.		Pickled.	
	Pounds.	Value.	Pounds.	Value.	Cases.[a]	Value.	Barrels.	Value.
Southeast Alaska:								
Dolly Varden	3,960	$200	400	$48				
Steelhead			26,461	2,645				
Total	3,960	200	26,861	2,693				
Central Alaska:								
Dolly Varden			100	10	54	$248	5	$40
Western Alaska:								
Dolly Varden					1,326	3,315	106	848
Grand total:								
Dolly Varden	3,960	200	500	58	1,380	3,563		
Steelhead			26,461	2,645				
Total	3,960	200	26,961	2,703	1,380	3,563	111	888

[a] Each case contains forty-eight 1-pound tall cans.

EULACHON.

The eulachon, or "hooligan," as it is popularly designated in Alaska, is a fish possessing valuable food properties. In appearance it is not unlike the smaller herring, but is much richer in oil. In some sections of southeast Alaska the Indians have long made use of this fish, primarily for its oil, which has been extracted by very primitive methods. They use this oil for food purposes, one favorite method of preparation being to mix it with salmon berries or other fruit. The oil from the eulachon possesses distinct medicinal properties, and in this respect is not unlike cod-liver oil. Some years ago a large pharmaceutical concern endeavored to exploit it, but with indifferent success.

During the year 3,032 pounds of eulachon, valued at $75, were dry-salted, and 37,333 pounds, worth $2,240, were handled in a fresh condition. This work was carried on by the Taku Canning & Cold Storage Co., at Taku Harbor, and by the Columbia & Northern Fishing & Packing Co., at Wrangell.

BLACK COD.

The black cod (*Anoplopoma fimbria*) is quite different from the true cod, not only as to appearance but particularly in the quality and texture of the flesh. It is very rich in fats and its delicate flavor makes it a favorite table fish in Alaska. It is not recognized as a very numerous species, and no definite fishery exists for it, catches generally being made incidentally by halibut fishermen. The black cod merits the growing favor with which it is being received generally. During the year shipments have been made from southeast Alaska of fresh, frozen, and pickled black cod.

SHIPMENTS OF BLACK COD FROM ALASKA IN 1912.

Products.	Pounds.	Value.
Black cod:		
Fresh	10,464	$623
Frozen	4,390	240
Pickled	1,800	90
Total	16,654	953

FUR-SEAL SERVICE.

By Walter I. Lembkey, *Agent in Charge.*

Instructions to the agent, dated May 16, 1912, directed him, as usual, to proceed to San Francisco and there purchase the provisions and other supplies needed for the Pribilof Islands. Under these instructions he left Washington May 19, arrived in San Francisco May 23, and immediately entered upon the duty to be performed there. The steamer *Homer* had already been chartered to transport the supplies to the islands, the charter price being $150 per day, including wages of crew. Owing to the limited appropriation which Congress had provided, it was necessary to restrict the purchases to the actual necessities, such as food, clothing, fuel, and medical supplies.

The *Homer* sailed from San Francisco May 27, reaching St. George Island June 12 and St. Paul on June 13. After discharging cargo and returning to Unalaska for coal for the islands, she sailed for San Francisco on June 28, with Assistant Agent James Judge on board, to purchase supplies which were to be sent to the islands on the second trip. Sailing again from San Francisco on August 4, the vessel arrived at St. George on August 24, but storms delayed unloading of the cargo, and the return voyage was not begun until September 11. With one of her two propeller shafts broken, the *Homer* finally arrived at San Francisco on September 27 with the year's catch of sealskins on board.

AFFAIRS OF THE COMMUNITY.

NATIVES' BANK ACCOUNTS.

Interest at the rate of 3½ per cent on the several natives' bank accounts on deposit with the Union Trust Co., of San Francisco, for the year ended December 31, 1911, was collected by W. I. Lembkey, trustee, and paid by him to the several owners of the accounts, in accordance with the receipted rolls transmitted to the Bureau of Fisheries and now in its files. Twenty St. Paul and nine St. George natives own such accounts, the amounts thereof aggregating $5,039.14.

During the year but one addition to the principal was made—$50 to the account of Simeon Fratis. Three withdrawals from principal were made—$25 each from the accounts of Simeon Fratis and John Hanson, both of whom are at the Chamewa Indian School, and $43.50 from that of Peter Oustigof, to pay for a sewing machine. The interest on the accounts of Hanson and Fratis was sent by money order to Chamewa and separate receipts returned.

Upon the death of Alexander Merculief, his nuncupative will, filed on St. Paul Island, distributed his bank account, $170, as follows:

Paul Merculief, jr	$30	Makar Merculief	$30
Auxenia Dynkanof	20	Mariam Merculief	30
Terenty Merculief	30		
Dosofai Merculief	30	Total	170

These heirs notified Trustee Lembkey that rather than have the cash they desired that the several amounts be deposited in the bank mentioned and accounts be opened with each in the name of W. I. Lembkey, trustee. Accordingly this action was taken.

The pass books representing the accounts in question have been transmitted to Assistant Agent Judge, together with blank checks signed by the trustee, in order that Mr. Judge may draw the annual interest next spring. This action is taken because of the fact that the trustee is in Alaska and will not be able otherwise to draw the interest.

Payments Made by W. I. Lembkey of Interest on National-Bank Accounts, Year Ended Dec. 31, 1911, on St. Paul Island, Alaska.

Names.	Amount of deposit.	Amount of interest paid.	Names.	Amount of deposit.	Amount interest paid.
Nicoli Bogadanof, guardian of Agrafina Bogadanof	$161.10	$6.08	Elizabeth Rookavishnikof	$40.00	$1.48
Apollon Bourdukopsky	203.30	7.66	John Stepetin, guardian of Maria Stepetin	40.00	1.48
Ouliana Gromof, guardian of Tekan Valkof, deceased	186.00	36.87	Akalina Fratis	426.00	16.09
Peter Bourdukopsky	130.00	4.89	Agrafina Fratis	71.00	2.66
Nekita Hopof	50.00	1.86	Akalina Fratis, guardian for Ouliana Fratis	71.00	2.66
Parascovia Kozlof	150.00	5.63	Akalina Fratis, guardian for Martha Fratis	71.00	2.66
Catherine Krukof, guardian of Alexai Emanof	230.00	8.67	Lukeria Galaktionef, guardian of John Hansen	311.33	13.42
Julia B. Krukof	150.00	5.82	Simeon Fratis	97.32	1.73
Alexander Melovidof	235.00	8.86			
Alexander Merculief	170.00	6.41			
Peter Oustigof	99.18	5.27	Total	3,957.23	150.66
Agrafina S. Pankof	285.00	10.76			

CENSUS OF NATIVE INHABITANTS.

On St. Paul, the annual census taken June 30, 1912, showed 196 native residents, of which 93 were males and 103 females. During the year 18 births and 2 arrivals occurred; and there were 6 deaths and 8 departures. A net increase of 6 over the native population of the year previous is shown. Of the males, 49 are adult, 27 between the ages of 5 and 16, and 17 under 5 years. Of the females, 53 are adult, 23 between 5 and 16, and 27 under 5 years.

On St. George, the total native population on June 30, 1912, was 106, 51 males and 55 females. During the year ending on the date mentioned, 7 births, 2 deaths, and 2 arrivals occurred. There was therefore a net increase of 7 over the previous year.

NATIVE POPULATION OF THE PRIBILOF ISLANDS, JUNE 30, 1912.

	St. Paul.	St. George.	Total.
Number present	196	106	302
Number males	93	51	144
Number females	103	55	158
Deaths	6	2	8
Births	18	7	25
Arrivals	2	3	5
Departures	8	....	8
Increase	6	7	13

VILLAGE WATER SUPPLY.

The native and other inhabitants of St. Paul are obliged to seek water for domestic purposes at wells over half a mile from the village. The water used by the white residents is hauled in barrels with mule team and stored in various tanks buried near the two residences. The water to be used by the natives is placed in small kegs at the well and then taken to the village in wheelbarrows. Rain water, of course, is saved, but the quantity is wholly insufficient for the natives' needs. The village is located on a little hill rising from a small sand flat, the greater portion of which is only several feet above sea level. Anywhere on this flat water may be found by digging less than 8 feet below the surface. As the sea, however, is only a few yards away, and as this flat has been used from time immemorial as a killing field, the water found by digging into it is not only brackish but quite greasy. The wells, about 3,000 feet from the village, are located on the nearest spot where pure water may be obtained by digging.

To bring water from these wells to the village hill, about 3,500 feet of pipe is necessary, together with a pumping engine to force the water through the pipes. While the ways and means of installing such a system have been considered for many years, the funds necessary to provide the material required were not available.

In 1910, however, the Navy Department erected a radio station on St. Paul Island, on the flat near the village. As the only drawback to the location was the absence of fresh water, the officers charged with the construction of this station were desirous of installing a pumping system to bring water to the radio buildings.

Having a fund for the purchase of the requisite material, the proposition was made by the Navy officers that if the natives would supply the labor necessary, the Navy would furnish the piping and pumping engine to bring the water from the well to the radio station and beyond to the village hill. On the latter tanks could be erected from which water could be piped to various places in the village.

The natives agreeing to perform the labor, a quantity of piping and a 5-horsepower gasoline pumping engine were brought to the

island on the wireless vessel *Nero*. Previous to the arrival, the natives, under Mr. Judge's direction, had dug out one-third of the trench line, but as the loose sand through which the trench was cut was constantly falling in, it was not deemed advisable to cut deeper than 2 feet until the pipe was ready to be laid.

On the *Homer* two 20,000-gallon redwood tanks (each 12 by 18 feet) were brought up to be installed on the flagstaff hill as a village reservoir. As the Navy representatives had no bricks with which to line a new wall, one of these tanks was set up on the site selected for a new well, the bottom removed, and the sides sunk to a depth of 8½ feet. To replace that used for the well, an additional tank was brought up on the second trip of the *Homer*.

Although with many difficulties, the work of running the pipe line from the wireless station to the top of the village hill and the erection and housing of the two tanks went on steadily, the natives doing all the work except the pipe fitting.

The tanks on the hill were sunk to a depth of 5½ feet and erected on a heavy foundation of redwood sills and joists. Over them a building 45 by 25 feet, and 8 feet high, with a three-fourths pitch roof, was erected. Of this the sides were made of 1 by 12-foot lumber, laid diagonally, to be faced with turf. The roof was shingled.

The trench was filled in whenever men to do the work were available. The sides of the tank at the new well, which projected 3½ feet from the ground, were faced with 2 feet of sod, a cover laid over the whole, and that turfed over.

When, however, the reservoir tanks and the pipe line were completed and the pump was started, the stream thrown into the tanks was found to be quite small and came with no force whatever. The pipe, of 1¼-inch diameter, is too small, offering more resistance to the flow than the pump is able to overcome. After working about one hour and pumping water equivalent to about 2 inches in one tank, the pump was wrecked, and it was necessary to request the Navy officer in charge of the radio plants to have spare parts supplied. These were to be brought from Nome on the revenue cutter *Bear*, which had not arrived at the time of writing this report, and it is therefore not known whether the pump was of service during the winter.

WORK ON RADIO STATION.

From July 1 to August 1 the time of all the men was occupied with two teams in hauling gravel for use in constructing concrete anchors for the guys on the two masts, excepting such little interruption as was caused by taking seals, etc. This gravel first had to be scratched from between the rocks at the East Landing beach, put into sacks, and carried on the men's backs for over 100 yards, to be placed

on the wagons and hauled to the proper spots. Much of it was thrown back from the water's edge at extreme low tide, to be carried back later. When the *Nero* arrived August 7, from 8 to 25 men were employed daily thereafter as laborers on the wireless erection work, for which they were paid 25 cents an hour. The *Nero* left August 26 and the *Homer* arrived two days afterwards. The gang then had to be split up to furnish men to complete the work which remained to be done at the wireless station.

SCHOOLS.

One of the requirements in the Government's contract with the Alaska Commercial Co., the first lessee of the sealing privilege on the Pribilof Islands, was that the lessee should "maintain a school on each island, suitable for the education of the natives of said islands, for a period of not less than eight months in each year."

And the lease of the North American Commercial Co., which succeeded the Alaska Commercial Co. in 1890, provided that the company should "provide and keep in repair such suitable schoolhouses as may be necessary, and to establish and maintain during eight months of each year proper schools for the education of the children on said islands, the same to be taught by competent teachers who shall be paid by the company a fair compensation."

In compliance with these requirements schools were maintained on the islands by the Alaska Commercial Co. and by its successor, the North American Commercial Co., during the periods of their respective leases.

The teachers supplied by those companies were usually, if not always, selected with reference to their ability to perform clerical or other duties rather than for their fitness as teachers. The companies seemed to regard the schools as a matter of secondary importance, and required the teachers to devote most of their time to work bearing no relation to the education of the native children. As a result, with a few notable exceptions, the persons who performed the duties of teacher had no special fitness or training for those duties.

It is not surprising, therefore, that no rational system of education has been worked out to meet the needs of those people and that so little progress has been made. Probably the best that has been done has been through the efforts of the wives of a number of the seal agents, who, although with no pedagogical training, took a kindly interest in the native women and girls and instructed them in elementary domestic science and art. They were taught to do plain sewing, making their own garments, and to do simple cooking. They were also instructed in the care and management of their homes and the care of children.

Mr. M. C. Marsh, naturalist on the seal islands during the year 1911–12, had general direction of all educational work, and has made a very interesting report on that subject, which is here printed in full:

On the voyage to the islands in August, 1911, I was enabled to discuss school matters with both the teachers, Mr. Ned B. Campbell and Mr. Philip R. E. Hatton. At the request of Mr. Campbell I gave him a letter of instructions. On St. Paul Island I have had frequent conferences with Mr. Hatton, the teacher, but beyond visiting the school several times and becoming responsible for the offer of a series of prizes to the pupils of each island for progress in the English language, I have left the management of the school to Mr. Hatton, who has already had a year's experience in teaching before coming to St. Paul.

By discussion with the teacher on St. George Island, who had already taught one year there, with the teacher and agents on St. Paul, by a perusal of Dr. Hahn's report on education of the natives, and by contact with the school and children here, I have come to appreciate that these teachers have a difficult task to bring about real progress on the part of their pupils. Elementary teaching being itself a difficult task, requiring skill and special qualification, the instructor of the Pribilof natives has other obstacles added, perhaps the chief of which is that teacher and pupil have command of no common language. The pupils think and speak among themselves the native tongue. The teacher has no practical use of this language, while the pupils do know a little English, and on this little, and its slow growth, the school makes such progress as it can. This reason for lack of advancement is well understood on the islands, and the whole subject of education of the natives has been discussed at length by Dr. Hahn, a teacher of wide experience. Without anticipating whether or how soon the radical recommendations made by him are to be carried out, it is apparent that the school year of 1912–13 will demand as the most pressing need an additional teacher for the younger children.

It is obvious that the use of the Russian language and the native tongue in all the church services to the entire exclusion of English, save a few sentences on certain holidays, is a serious obstacle to the use of English among the natives, especially among a people who give so much time to church services and religious forms and observances as the Aleuts of these islands. The ritual is in Russian. The present priest on St. Paul Island speaks Russian and English, understands Aleut, but does not attempt to use it directly in the church service. The reader, a novitiate in the church priesthood, translates his words, sentence by sentence, from Russian to Aleut. Thus in the church the people hear no English spoken or sung, nor see it printed.

The remedy for this state of things seems not to be difficult. The church authorities do not require the use of Russian in the church. Any language is permissible. The present priest on St. Paul Island has never been in Russia, ostensibly regards himself as an American, and will confess to no prejudice in favor of the Russian language. He speaks English well enough and would use it before his congregation, but has not considered the reader able to translate with sufficient facility from English. This is probably not the case, and I think both will agree upon a trial of English. The priest has promised to request, by the next mail, of his church superiors the English forms for his church ritual. It is probably feasible to make the change indicated after some delay.

The attendance at the school on St. Paul Island averaged 40 pupils per day, out of a maximum enrollment of 43. Of these 43 the infant class included more than 20. The number of boys enrolled is slightly greater than the number of girls. There are 173 school days in the

term, excluding 13½ church and Russian holidays and 4 American national holidays.

The curriculum is the simple one of reading, writing, spelling, and arithmetic, adjusted to five grades besides the primer class. History is introduced in the third grade; geography, good health, and grammar in the fourth.

The offer of six prizes in reading and speaking English proved a stimulus which produced excellent results. The difficulties of the teachers' task, however, are so great as to call for immediate attention, as shown by the following extract from the report of Mr. Philip R. E. Hatton, of the St. Paul school:

> In closing my report for the year I beg to call attention to the urgent need for an assistant teacher and a new school building on this island.
>
> It is impossible for one person to teach a school of 43 children, varying in ages from 6 to 16 years, and obtain anything like satisfactory results. Forty-three pupils are too many for one teacher in any locality, but teaching these children can not be compared to the work of teaching school in the States. These little Aleuts, until they reach the age of 10 or 11 years, can hardly speak a single word of English. They have to be taught to speak and to understand when spoken to before anything else whatever can be taught them.
>
> Every pupil in this primer class, moreover, should be taken separately and taught slowly, with everything explained thoroughly. But there are twenty-odd members in this class, and five other classes waiting to be instructed. To give the school proper attention, at least half an hour should be devoted to each recitation of each class, and I could hardly spare 10 minutes to each class and do the rest of the work.
>
> It is almost impossible to maintain order in the schoolroom where so many of these children are and continue the work. The little ones can not be given work enough to keep them busy all the morning, and it is not in their disposition or home training to sit still while congregated in the building.
>
> Most of the children show an aptness for learning and would all make rapid progress if they were only given the chance. But the infant class, the largest, has no chance to get a start. If these children are to be properly taught, it is essential to separate the higher grades from the infant class and teach them in separate rooms.
>
> For this, of course, a new schoolhouse will be required. Even the help of another teacher in the same room would be but small improvement. No schoolroom is large enough for two teachers to work in at the same time. The present building is too small to have rooms partitioned off for different classes, and the building itself is far from being a modern or comfortable structure, having been built, I understand, in the seventies, and without any convenience.
>
> I would recommend, therefore, that a modern and attractive schoolhouse be built, well ventilated, and with one or more playrooms for the children. The weather here in the winter is such that the children can not play outside without getting wet feet and then colds, and worse sicknesses are the certain results. A comfortable and attractive building is needed to induce the children to attend school willingly. Such a school could be built very cheaply, since all the labor of construction could be furnished free by the natives.
>
> It will, of course, not be possible to have a new school building ready for use this coming winter, but there are several unoccupied houses in the village, one of which could be used by a part of the pupils for a year or two, if it is made possible to so separate them by sending up an assistant teacher this year.

In the education of the natives I believe that they should not be taught book studies only or even chiefly. They should have practical instruction in some useful trades. Therefore I respectfully recommend that a small manual-training course be started in connection with the school. A good outfit could be purchased for $150 or $200, and it would last for an indefinite length of time. An ideal plan would be to use the present school building for a workshop in which the manual-training course would be taught, and have a new frame schoolhouse large enough to accommodate all the children built near by.

The school on St. George Island is smaller than that on St. Paul. The enrollment in 1911-12 was: Boys, 13; girls, 10; total, 23. This school has apparently never received the attention and careful supervision necessary to even fair efficiency. An effort is now being made to improve it.

FUR-SEAL HERD.

BRANDING YOUNG MALE SEALS FOR BREEDING RESERVE.

The instructions of the Department called for a reservation for breeding purposes of 2,000 3-year-old male seals, 1,600 on St. Paul and 400 on St. George. In compliance with these instructions, seals of the required class were marked and reserved on St. Paul Island as follows:

YOUNG MALE SEALS BRANDED FOR BREEDING RESERVE ON ST. PAUL ISLAND.

Date.	Rookeries.	Number.	Date.	Rookeries.	Number.
July 3	Reef	353	July 10	Tolstoi	55
4	Tolstoi	50	11	Zapadni	62
5	Zapadni	93	15	Northeast Point	215
8	Northeast Point	165	16	Reef	301
8	Halfway Point	60			
9	Reef	251		Total	1,605

The branding or marking consisted in shearing or clipping with sheep shears the hair and fur from an area of suitable size on the top of the head. The mark was made sufficiently plain to be easily distinguishable throughout the season. Care was taken, as heretofore, to select for reservation the best examples of 3-year-olds that appeared on the hauling grounds, and special care was taken that none of the seals marked for reservation should be killed.

The same method of providing a breeding reserve was observed on St. George Island, and the following reservations were made:

YOUNG MALE SEALS BRANDED FOR BREEDING RESERVE ON ST. GEORGE ISLAND.

Date.	Rookeries.	Number.	Date.	Rookeries.	Number.
July 5	North	65	July 19	North	105
8	East	60	20	East	65
11	North	35			
15	Staraya Artel	70		Total	400

Those secured on July 5 and 8 were branded with a hot iron. Those on July 11, 15, and 20 were clipped with shears, after which a light hot-iron brand was placed on the clipped area. Those branded on St. George were of the best appearing in the drives.

REJECTION FROM DRIVES.

In the regular food-killing drives in the season of 1912 only large 2-year-olds were killed; all others were rejected.

The following table shows the number killed and the number of each class rejected in each regular drive:

SEALS REJECTED FROM DRIVES.

Date.	Hauling ground.	Seals killed.	Rejections.						Total.
			Small.	4 years old.	5 years old.	6 years old.	7 years old.	Branded.	
1912.	St. Paul Island:								
July 9	Reef	110	1,205	23	17	10	2	451	1,818
16	Reef	127	423	7	5	0	2	355	919
24	Reef	382	623	37	21	4	0	117	1,184
27	Reef	439	1,058	16	6	1	0	111	1,631
31	Reef	223	572	19	18	8	0	77	917
Aug. 11	Reef	363	488	25	12	4	1	96	989
	Total	1,644						1,207	
	St. George Island:								
July 20	East	38	70	2	2	1	4	65	182
24	East	35	96	4	1	3	3	33	175
26	North and Staraya Artel	132	475	14	9	2	2	105	739
29	East	62	110	5	2	1	1	39	220
31	North and Staraya Artel	134	237	3	3	1	1	63	442
	Total	401	988	28	17	8	11	305	1,758
	Grand total	2,045						1,512	

KILLING OF SEALS.

On St. Paul Island the number of seals killed from August 11, 1911, to July 3, 1912, was 1,193; the number taken between July 3 and August 12, 1912, was 1,687, a total for the year ending August 11, 1912, of 2,880, which number was shipped from St. Paul Island to San Francisco on the *Homer* September 10, 1912.

On St. George Island the number killed from August 11, 1911, to July 3, 1912, was 438; the number taken between July 3 and August 12, 1912, was 446, a total for the year ending August 11, 1912, of 884, which number was shipped from St. George Island to San Francisco on the *Homer* September 12.

The total number of skins taken on the Pribilof Islands in the year from August 11, 1911, to August 11, 1912, both inclusive, was therefore 2,880 on St. Paul Island and 884 on St. George Island, a total of 3,764, all of which were shipped from the islands on September 12, 1912.

Owing to the small number of seals taken, practically no seal meat was available for salting for winter use and none was preserved for fox food; nor was it possible to send any seal meat to Unalaska, as has hitherto been the custom, for the use of natives there.

Following is a detailed statement of the killings:

SEALS KILLED ON ST. PAUL AND ST. GEORGE ISLANDS IN THE YEAR ENDED AUGUST 11, 1912.

Date.	Rookeries.	Number.	Date.	Rookeries.	Number.
1911	St. Paul Island:		1911.	St. George Island:	
Aug. 11-24	Northeast Point	115	Aug. 10	North	44
Oct. 19	Reef	221	10	Zapadni	1
Nov. 4	Reef	210	Oct 20	North	75
Dec. 2	Sea Lion Rock	126	28	East	35
4	Northeast Point	102	28	Zapadni	3
12	Sea Lion Rock	138	Nov. 2	Staraya Artel	74
			2	Zapadni	6
	Total	912	7	North	95
1912.			17	North	85
May 18	Sea Lion Rock	45	Dec 3	North	1
28	Sea Lion Rock	83	4	Staraya Artel	1
28	Reef	13	28	North	5
30	Northeast Point	10			
June 9	Reef	108		Total	425
Spring	Taken by watchmen at various times and places.	22	1912.		
			June 9	East	13
			July 5	North	18
			5	Zapadni	2
	Total	281	19	North	16
			20	East	38
July 3	Reef	5	24	East	35
8	Northeast Point	20	24	North and Staraya Artel.	132
9	Reef	110			
16	Reef	127	26	East and Zapadni	3
16	Northeast Point	8	29	Zapadni	1
21	Zapadni	4	29	East	62
24	Reef	382	31	North and Staraya Artel.	134
27	Reef	439			
31	Reef	223	31	Zapadni	5
Aug. 5	Northeast Point	6			
11	Reef	363		Total	459
	Total	1,687		Total, St. George.	884
	Total St. Paul	2,880		Grand total	3,764

AUTHENTICATION OF SEALSKINS.

Article III of the convention of July 7, 1911, for the protection of the fur seals and the sea otters of the North Pacific, engages each of the signatory powers to prevent the importation into their territory of any skins of fur seals belonging to any of the three species inhabiting the North Pacific except such as "have been officially marked and certified" as having been legally taken.

To carry out the provision of the treaty requiring the marking of all skins from seals authorized to be taken from the Pribilof herd, the Bureau last spring furnished the islands with 11,000 leather tags (St. Paul 8,000 and St. George 3,000 tags), those on St. Paul being severally numbered P1 to P8000, and those on St. George from G1 to G3000. These numbers were deeply stamped into the tags and not printed thereon, in order that the action of salt and water might not obliterate the numbers.

The tags, for convenient use, were each provided with about 18 inches of twine, doubled in the middle and looped through a hole in the tag. They were next arranged severally on wires, 200 to each wire. These tags, as many as might be needed, thus could be carried about to be affixed to skins without danger of disarranging the sequence of numbers.

On St. Paul, during the season ending August 11, 1912, each skin was given a numbered tag beginning with no. 1 and running consecutively to no. 2880, which last number represented the total number of skins taken. Such skins as will be taken on St. Paul hereafter will be numbered from 2881 consecutively until each of the skins taken has been furnished with a tag. Through a misunderstanding of instructions by the assistant agent in charge on St. George Island only the skins taken on that island during the regular killing season (July) were tagged. These were 446 in number and received tag numbers G1 to G446, both inclusive.

MARKING, WEIGHING, AND MEASURING SEALSKINS.

The tags were attached to the skins after the latter had been brought to the salt house. There the skins were placed on one of the outside platforms and about six men engaged in the work of tagging them. This was done by tying the 18-inch loop of string attached to the tag through one of the flipper holes. The tagged skins were then carried into the salt house and placed on a large table, care being taken that the skin should not come into contact with salt until after its green weight was taken. On the table with the skins was a small pair of beam scales, with a scoop on one side and counterpoise and loose iron weights on the other, and with a brass notched plate in front, graduated to quarter ounces and provided with a movable poise. The scales were manufactured by Fairbanks-Morse, and were calibrated with weights furnished by the subtreasury in San Francisco. To facilitate weighing, each skin on the table was folded up into a compact bundle with its tag hanging outside. A series of sheets of paper serially numbered also had been prepared.

In weighing, each skin was taken up from the table by one man who announced the number on its tag to the man who was to record the weights. The skin was then laid on the scoop and the scale carefully balanced by a third person, who announced the weight of the skin. This weight as announced was written down on the serially numbered sheets in the space opposite the proper tag number. After this number was recorded and checked back, the green skin was for the first time tossed aside upon the loose salt. When all the skins in the killing had been weighed, they were salted in kenches. After five days they were taken out of the kenches, examined on a

table for places defectively salted, and then more lightly salted outside the kenches in a pile called the "book."

Under usual circumstances, the weight of the salted skin was not ascertained until it was taken out of the book for bundling. In the case of over 200 skins, however, the salt weights were ascertained immediately upon being taken out of the kench, and likewise again when taken out of the book. A report on these latter skins, with the data obtained from weighing them out of the kench, appears elsewhere.

In recording the salt weights the sheets previously used for recording the green weights were again taken into the salt houses, and the salt weights inserted thereon in the blank spaces left for that purpose opposite the serial number and the green weight. At the time of taking the salt weights the salted skin was also measured for greatest length along the median line of the back, and for greatest width across the skin at the fore-flipper holes. These measurements were also recorded opposite the serial number and the weights, so that each sheet contains a completed record of the serial number, green and salt weight, and salt measurement of each skin recorded on it. Copies of these completed sheets are on file at the Bureau of Fisheries.

In making these data, as before described, the greatest attention was paid to accuracy. Having only a few skins, there was time enough to weigh and measure each skin carefully. To kill some 200 seals, however, and to weigh the skins in the manner in which it was done last summer occupied the time from early morning until after 3 in the afternoon, a delay that will be impossible when the number of skins taken becomes larger. It was thought, however, that if complete data regarding the changes that might occur to skins through salting were gathered this year, it would establish a principle, and would make it unnecessary to repeat the labor in subsequent years.

SPECIAL EXPERIMENTS IN MEASURING AND WEIGHING SEALSKINS.

In addition to comparing the weights of skins green and after salting, and ascertaining their measurements in the salted state, efforts were made to obtain also as accurate information as possible of the measurements of skins when green—i. e., before being salted—with a view of determining what change, if any, occurs in the size of the skin from the action of salt. To acquire this information it was necessary to measure the animal before it was skinned, to measure the fur remaining on the animal after skinning, to measure as accurately as possible the green skin itself, and, finally, to measure the skin after it had been in salt.

It has been a much-mooted question whether green skins could not be measured and thereby furnish a much better test of the age of the animal than the present method of weighing the skin. By those

familiar with the subject it has been contended that the skin when green is so elastic and pliable that by the smallest pressure it can be made to stretch inches; also that the tendency of the green skin is to retreat or curl into itself, and merely to uncurl it requires pressure enough to stretch the skin in any direction the pressure may be applied. To have actual experiments made in attempts to measure green skins was the only exact method known of determining the question raised, and was the object of the work about to be detailed.

On July 9, 110 large 2-year-old seals were killed for this purpose and to furnish food for the natives. The method employed was as follows:

The seals were first stunned by clubbing and laid in a row. One of the serially numbered leather tags already mentioned was then affixed to the hind flipper of each seal. This remained until the skin was removed, when the tag was at once taken off the flipper and tied to the skin in the flipper hole, from which place it was not thereafter removed. This insured the identification of the skin with the weights and measurements made before skinning. The length of each animal from tip of nose to root of tail was then ascertained by means of a steel tape laid along the middle of the back. The girth was next ascertained by drawing the tape around the animal just back of the fore flippers. The weight of the entire animal was then ascertained, after which it was bled to death.

When dead, the usual incisions were made preparatory to removing the skin from the carcass, as follows: One incision along the belly from the jaw to the anus; another, a circular incision, beginning at the jaw completely around the head and as close to the eyes as possible; another circular incision beginning at the anus around the posterior end of the body, completely denuding that portion of the body of fur and leaving the entire tail appended to the skin, and also cuts around each fore flipper near the elbow, just beyond the fur.

After the circular incision was made about the head, the length of the "mask," as is termed the fur remaining on the animal after it has been skinned, was ascertained. This was done by laying a steel tape on the back of the head on the same line on which the length of the animal was ascertained, and measuring the mask from the circular incision to the tip of the nose. By these means were ascertained the length and width of the pelt while on the animal, and the length of the area of the fur left on the animal after the skin was removed. If no changes occurred in the size of the skin through the operation of removing the pelt, or through salting, it would follow that the length of the skin should equal the total length of the animal from tip of nose to root of tail, after deducting the length of that portion of the skin left on the head by the skinners. The width of the skin should equal the girth of the animal.

It should be recalled that the measurement of the animal was taken to root of the tail, and that the root of the tail, as well as the tail itself, was removed with the skin. In computing what should be the normal length of the skin after removal, therefore, no deduction should be made on account of any supposed portion of tne pelt left on the posterior end of the animal, as no skin with fur on it remains on that portion of the carcass after skinning.

After weighing the animals in the field and measuring them, as before stated, the carcasses were skinned and the skins taken to the salt house. There each skin was weighed and the weights so taken arranged serially according to the numbers borne by the tags affixed to each skin.

Before salting these skins, however, an effort was made to arrive at something approaching the true dimensions of these green skins. The proper method of obtaining these data, if any proper method existed, had been discussed previously by Messrs. Marsh, George A. Clark, and Lembkey. Knowing the elastic and pliable nature of a green sealskin, it was believed that no method could be devised of obtaining the dimensions of such a skin which would in any way compare consistently with the dimensions of the same skin after it was salted. On this point all were agreed. It was hoped, however, that although the green and salt dimensions never could be correlated satisfactorily, perhaps some method could be devised for measuring the green skins, which, used upon all alike, might have some value. It was suggested that each green skin be held up by its tail against a pole graduated with inches or centimeters, until its other end barely touched the ground, and its length as shown recorded. The skin, in this manner, would be stretched merely by its own weight, and the length obtained be a fair, or at least a somewhat reliable, indication of its size and also its age.

It was also suggested that the quantity of blubber on the skin would be a vital element in using this method, and would influence the length greatly, without regard to the age of the animal. For example, if two seals of exactly the same size were skinned, one with only a small quantity of blubber on the skin and the other with a large quantity of blubber, the heavily blubbered skin would be the longer when measured by the method suggested, and therefore appear as the skin of a larger animal because the weight of the blubber would stretch it farther. It was then suggested that a fair attempt could be made to arrive at the size of a skin when in a green state by having the men lay each green skin in the kench for salting, and in that state, just before salt was thrown upon it, to measure the skin for length and breadth, without any further attempt to straighten it out. This method seemed by far the most sensible in attempting to measure green skins, and it was tried.

Accordingly, before these skins were salted, but after each was laid in the kench by the native workmen preparatory to having salt thrown upon it, it was measured by laying a steel tape across its greatest length and width as it lay. The number on the tag which each skin bore was noted also, and the measurements arranged in accordance with these numbers. No instructions were given to the men as to how to lay the skins in the kench previous to measuring them, except that they should be laid as ordinarily they would be laid for salting. No instructions whatever were given the native men as to how the seals should be skinned, i. e., whether more or less blubber should be left on the skin.

These skins were then salted by having three shovelfuls of salt thrown upon each. This is one more shovelful than would be thrown upon them were a large number to be salted. On July 17, eight days after they were first salted, they were hauled out of the kench, measured and weighed, and again salted, but more lightly, in the book.

On July 16, another 100 seals, approximately, were treated in exactly the same manner as were those taken on July 9. On July 22, six days thereafter, they were hauled out, weighed and measured again, and booked.

From these 210 skins interesting data were gathered. So far as the weights are concerned, it is shown that without exception these skins lost weight in salt during periods of eight and six days, respectively. Some lost as much as 10 per cent, some lost only a fraction of 1 per cent; but without exception all lost weight. Moreover, the salted weights of all skins taken during the summer, including the 210 specially mentioned here, when contrasted with the green weights of the same skins, demonstrate the fact that over 95 per cent thereof lost weight through salting.

As regards measurements, the data show that by the best methods that could be devised it was not possible to measure a green skin within inches of its subsequent dimensions after salting. It was found, furthermore, that the measuring of green skins in the kench just before salting so delayed and confused the native workmen that the time necessary to salt each 100 skins was increased more than one hour while numerous inaccuracies in salting were discovered afterwards, which undoubtedly were due to the confusion incident to measuring, and which had they not been discovered within a week would have seriously depreciated the value of the skins.

The table of measurements constructed from these operations is interesting in showing that at no time after the pelt has been removed from the carcass does it assume the dimensions it had while on the animal. While the time necessary to prove the fact has not been

afforded, it is believed that the skin on the live animal is in a state of tension, varying in degree as the animal may be fat or lean—if fat, the tension is greater; if lean, the tension is less. A contraction of the skin seems to occur immediately upon its removal from the animal; whether this is due to the releasing of the natural tension of the skin, or whether there is an actual muscular contraction due to the reflex of muscles which continued to contract for a short period after death, it is not possible to say. It is certain, however, that as accurate a measurement of the green skin as can be made shows that it is inches shorter and narrower than before its removal from the body. The effect of salting was to increase in every instance the size of the green skin as ascertained previous to salting. However, neither the length nor the width of the salted skin equals that of the same skin on the animal. This can be made more apparent by a scrutiny of the table of comparative sizes of green and salted skins, with the length and width of that skin on the animal.

On July 27, 10 skins were picked out at random from those lying on the pile with only the hair side exposed, and were weighed just as they came from the field. After this first weighing they were given to expert skinners with instructions to remove carefully all blubber from each pelt. After the blubber was so removed the skins were weighed again and salted. On August 1 and 7 they were again weighed. The results of the weighing are here given in detail:

WEIGHTS OF SEALSKINS WITH AND WITHOUT BLUBBER AND BEFORE AND AFTER SALTING.

Serial number.	With ordinary blubber.		With no blubber.		Aug. 1, after 5 days salting.		Aug. 7, after 11 days salting.	
	Pounds.	*Ounces.*	*Pounds.*	*Ounces.*	*Pounds.*	*Ounces.*	*Pounds.*	*Ounces.*
675	6	12	5	1.75	4	13.25	4	14.75
676	6	8	5	1.25	5	2.25	5	3.75
677	6	14.5	5	6.25	5	2.25	5	5.75
678	6	14.75	5	2.75	5	1.75	5	5.5
679	5	4	3	7.25	3	8.5	3	9
680	6	14.75	4	12.5	4	11.25	4	12.5
681	7	1.75	5	4.5	5	....	5	1
682	6	13.25	4	12.75	4	8	4	12
683	6	15.5	4	13.75	5	.5	4	15.25
684	5	6.75	3	14.75	4	2.5	4	3.25
Total	65	9.25	47	13.5	47	2.25	48	2.75

This is an interesting experiment on the effect of salt upon skins from which all blubber was removed before salting. These skins when salted green, however, were dry, i. e., carried no moisture other than the animal juices, whereas after salting they were dripping wet from the water in the bottom of the kench, where they had been salted. The result, nevertheless, would indicate that the greatest loss in weight through salting occurs from the blubber adhering to the skins, and not from the skins themselves.

The net result of all these experiments is to show conclusively that sealskins do not gain weight in salt, but on the contrary lose weight

through the action of the salt on them. Were it possible to have all skins taken off the carcass with a uniform thickness of blubber adhering, to have them at the time of salting each carry the same amount of moisture, and to have each absorb the same amount of moisture while in salt, it is certain that each skin would show the same percentage of loss in weight through salting. It is impossible, however, to have these conditions uniform. If the day be dry, the fur on the skin will be dry, and will be salted without moisture other than that furnished by the natural animal juices in the pelt. If the seals on such a day are "dipped" in a pond before killing, as often occurs, or if rain be falling at the time of killing, the skins will reach the salt house with varying quantities of moisture and be salted in such condition. When afterwards the skins are weighed out of salt, the differing amounts of moisture in them undoubtedly will affect accordingly the percentage of loss in weight.

It must be understood, also, that moisture, both from that carried in the fur, if the fur be wet when salted, and that extracted from the pelt itself by the action of the salt, is expressed from the skins in salt by the pressure of the skins above when salted in the kench and when in the pile known as the book. Water always is found on the floors of kenches, and those skins at the bottom are immersed in it. Likewise, there is always seepage from the book of liquid from the upper skins which saturates those skins salted below them. When these wet skins are weighed out of salt they must of necessity weigh more, because of the presence of this moisture, than those from which the moisture has been extracted, thereby causing a variation in the percentage of loss in weight through salting.

It must be remembered, furthermore, that probably no two skinners skin seals alike. Some skinners unknowingly leave more blubber on than do others. Some leave a uniformly thin layer of blubber over the entire skin, and others, because of a relative lack of skill, will leave irregular patches of blubber of varying thickness. Others, because of an eccentric manner of holding the skinning knife, will shave the skin closely with the point, but will leave the blubber much thicker toward the haft. If the skin carries blubber of equal thickness over its whole surface, necesssarily the action of the salt will be uniform over the entire skin. If, on the other hand, the skin contains blubber in areas of uneven thickness, or if it carries blubber on some portions and no blubber on other portions, the action of the salt will be unequal in effect, because salt can not penetrate a thick mass of blubber as quickly as a thin layer.

So also, new salt, which contains many fine particles as well as the coarse grains, will act more quickly and effectively upon skins than will old salt. The smaller particles in the new more readily dissolve and form solution; besides, the old salt has become more or less

coated with grease from previous contact with skins; the smaller particles have been dissolved for the same reason, leaving only the larger grains, which dissolve less readily. These, and perhaps all other elements, operate to change or vary the percentage of loss of weight from sealskins through salting. That these skins almost invariably do show a loss of weight through the action of salt on them is remarkable in view of the many factors which operate to influence the weight.

If a test must be applied by which the work of killing seals on the islands is to be checked, that test should be by weighing the skins as heretofore, and not by measuring the skins, as has been suggested. The test of weight can be applied immediately after the animal has been killed and skinned, and thereby a close connection can be kept in the minds of the workmen between the size of the animals taken and the weights of their skins. On the other hand, it has been shown that no test of the size of the skins which is worthy of consideration can be taken until at least five days after the animals have been driven, slaughtered, and skinned. If the killing gang must wait five days before knowing whether the seals taken on any date are taken conformably to regulations, or the contrary, it is submitted that the information, when finally obtained, will lose much of its value.

These tests are useful, not so much in instructing the sealers as to their duties, but in convincing others that the work of the sealers is in conformity with regulations. Assume, for example, that the regulations prescribe the killing of 2-year-olds only. It is obvious that whatever test is prescribed, whether by the weight or size of skins, can not be applied until after the animal has been killed and skinned, when it is too late to rectify any mistakes with regard to their taking. The clubber must first kill the seals before he can either weigh or measure their skins, and in selecting them for killing he must depend solely upon his judgment and his experience. He must be able to tell accurately the ages of the seals coming before him, and he must, in advance of weighing, guess the weight of a skin on a live seal to within a few ounces. So far as is known, there is no method whereby to determine mathematically the age of a seal, or the size and weight of its skin previous to the death of the animal. Any method, therefore, can not be an aid to the seal killer except in so far as he may by it be able to verify the accuracy of his work after it has been done.

The various weights and measurements of seals and sealskins taken during the summer are appended.

COMPARISON OF GREEN AND SALT WEIGHTS OF SEALSKINS TAKEN ON ST. PAUL ISLAND IN JULY, 1912.

In salt July 9 to 16, inclusive.

Serial No.	Green weight.		Salt weight.		Decrease.		Serial No.	Green weight.		Salt weight.		Decrease.	
	Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Oz.*	*Per ct.*		*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	*Oz.*	*Per ct.*
26	5	0.25	4	10.5	5.75	7	81	5	8.5	5	1.25	7.25	8.1
27	4	2	3	14.25	3.75	5.6	82	5	0	4	13.25	2.75	3.4
28	5	15.5	5	8.5	6	6	83	5	10.25	5	4.75	5.5	6.1
29	6	2.25	5	10.25	8	8	84	5	12.75	5	5.5	7.25	7.8
30	5	5	4	15.25	5.75	6.7	85	5	9.75	5	5.25	4.5	5
31	6	7.75	6	2.25	5.5	5	86	5	12.75	5	6.75	6	6.4
32	5	12.25	5	4.75	7.5	8	87	5	6	5	.25	5.75	6.6
33	6	1.25	5	7.75	9.5	9.7	88	5	14.25	5	8.25	6	6.3
34	5	2	4	13.5	4.5	5	89	6	6.75	6	.5	6.25	6
35	5	0	4	10.5	5.5	6	90	6	10.25	6	3.75	6.5	6.1
36	4	14.5	4	8.25	5.25	6.6	91	[illegible]	2.5	[illegible]	14.75	3.75	4.5
37	5	2.75	4	12.5	6.25	7.5	92	6	13.75	6	7.5	6.25	5.6
38	5	12.25	5	7	5.25	5.6	93	6	6.75	5	15	7.75	7.5
39	4	11.75	4	8.25	3.5	4.6	94	4	6	4	2.5	3.5	5
40	5	7.75	5	0	7.75	8.8	95	6	5.25	5	13	8.25	8.1
41	6	10	6	3.25	6.75	6.7	96	5	15	5	7	8	8.4
42	5	6.75	5	3.5	3.25	3.7	97	7	14.75	7	5.25	9.5	7.4
43	6	1.5	5	9.75	7.75	7.9	98	7	7.75	6	15.25	8.5	7
44	6	.75	5	9.25	7.5	7.7	99	6	10		4.5	5.5	5.1
45	6	2.25	5	13.25	5	5	100	6	12.75	6	9.75	3	2.7
46	5	5.25	5	1.75	3.5	4	101	6	3.5	5	10.25	9.25	9.2
47	4	8.5	4	3.75	4.75	6.5	102	7	5.5	6	14.75	4.75	4
48	4	14	4	11.5	2.5	3	103	6	15	6	10.75	4.25	3.8
49	5	10.25	5	1.25	9	9.9	104	6	12.5	6	8	4.5	4.1
50	5	5.5	5	0	5.5	6	105	6	1.25	5	14.75	2.5	2.5
51	5	14.25	5	8.5	5.75	6	106	7	2.75	6	14.25	4.5	3.9
52	6	3.5	5	10.75	8.75	8.7	107	6	4.25	6	.75	3.5	3.4
53	6	10.5	6	5	5.5	5	108	7	0	6	6.5	9.5	8.4
54	5	15.25	5	8.5	6.75	7	109	7	15	7	11.5	3.5	2.7
55	5	14.75	5	8.5	6.25	6.5	110	6	2.5	6	2.25	.25	.2
56	5	3	4	13.5	5.5	6.6	111	5	1.75	4	15	2.75	3.3
57	5	13.5	5	7.75	5.75	6.1	112	7	6.5	6	14.5	8	6.7
58	5	7.5	5	3.25	3.75	4.2	113	6	14.75	6	9	5.75	5.1
59	6	7.5	5	15	8.5	8.2	114	6	14.5	6	6.75	7.75	7
60	5	0	4	11.5	4.5	5.6	115	6	2.75	5	11.25	7.5	7.5
61	5	8.75	5	1.25	7.5	8.4	116	5	10.25	5	6.25	4	4.4
62	5	7.5	5	2.5	5	5.7	117	7	.25	6	7.5	8.75	7.7
63	5	15.25	5	6.25	9	9.4	118	7	0	6	15.75	.25	.2
64	6	11	6	3.25	7.75	7.2	119	7	4.5	7	3.5	1	.8
65		11.75	6	3	8.75	8.1	120	6	15.75	6	8.25	7.5	6.7
66	6	7.5	6	1.75	5.75	5.5	121	6	3.75	5	15	4.75	4.7
67	5	15.25	5	9.25	6	6.2	122	7	8	7	1.75	6.25	5.2
68	4	14.25	4	10.5	3.75	4.6	123	5	15	5	10.75	4.25	4.4
69	5	6.25	5	.75	5.5	6.3	124	7	0	6	8.5	7.5	6.6
70	5	5.75	5	2.25	3.5	4	125	7	14.5	7	4.5	10	7.9
71	6	6	5	12	10	9.8	126	6	12.25	6	8	4.25	3.9
72	6	2	5	15.25	2.75	2.8	127	5	15.75	5	12.25	3.5	3.6
73	5	5.75	4	14.25	6.5	7.5	128	5	5.75	5	3.5	2.25	2.6
74	4	2.25	3	15	3.25	4.9	129	4	8.75	4	5.25	3.5	4.8
75	5	12	5	5.5	6.5	7	130	5	8	5	5.5	2.5	2.8
76	5	7.75	5	3	4.75	5.4	131	5	5	4	3.5	17.5	20.5
77	5	9	5	5.25	3.75	4.2	132	5	7.5	5	5.25	2.25	2.5
78	5	15.5	5	12	3.5	3.6	133	5	3.25	4	12.75	6.5	7.8
79	4	14.75	4	9.25	5.5	6.9	134	4	7.75	4	5.5	2.25	3.1
80	4	14	4	11	3	3.8	135	5	4.75	4	15.5	5.25	6.1

In salt July 16 to 21, inclusive.

136	6	2.5	5	11.5	7	7.1	152	7	11.25	7	0	11.25	9.1
137	5	12	5	5.25	6.75	7.3	153	6	7.5	5	15	8.5	8.2
138	5	5	4	15.75	5.25	6.1	154	6	7.75	6	1	6.75	6.5
139	6	5.25	5	12	9.25	9.1	155	7	1.5	6	12	5.5	4.8
140	5	15	5	8.5	6.5	6.8	156	7	0.25	6	9.75	6.5	5.7
141	5	1	4	12.25	4.75	5.8	157	7	0.25	6	7.5	8.75	7.7
142	5	12	5	8.25	3.75	4	158	5	2.75	4	14.25	4.5	5.4
143	5	8.75	5	2.75	6	6.7	159	6	7.75	5	10.5	13.25	12.7
144	4	12.5	4	11.75	0.75	0.9	160	6	5	5	10.25	10.75	9.6
145	5	9.5	5	3.25	6.25	6.9	161	5	8.25	5	0.75	7.5	8.5
146	5	13.25	5	10	3.25	3.4	162	6	15.25	6	11.5	3.75	3.3
147	5	13.25	5	5	8.25	8.8	163	5	3.5	4	14.75	4.75	5.6
148	7	3	6	14.5	4.5	3.9	164	7	9	7	1.75	7.25	5.9
149	5	8	5	3.5	4.5	5.1	165	5	7.5	5	1.5	6	6.8
150	5	14	5	6.5	7.5	7.9	166	6	15.5	6	3.25	12.25	10.9
151	7	2.25	6	8.5	9.75	8.5	167	7	2.25	6	10.25	8	7

Comparison of Green and Salt Weights of Sealskins taken on St. Paul Island in July, 1912—Continued.

In salt July 16 to 21, inclusive—Continued.

Serial No.	Green weight.		Salt weight.		Decrease.		Serial No.	Green weight.		Salt weight.		Decrease.	
	Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Oz.*	*Per ct.*		*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	*Oz.*	*Per ct.*
168	5	3	4	12.25	6.75	8.1	220	5	6	5	2.5	3.5	4
169	4	12	4	10.5	1.5	1.9	221	6	10	6	1.5	8.5	8
170	5	9	5	5.75	3.25	3.6	222	5	6.5	4	15	7.5	8.6
171	6	0.5	5	12	4.5	4.6	223	5	7.5	5	1	6.5	7.4
172	6	2.75	5	13.75	5	5	224	5	1.75	4	14	3.75	4.6
173	6	0	5	11.75	4.25	4.4	225	4	3.25	4	1.25	2	2.9
174	5	9.5	5	3	6.5	7.2	226	5	8.75	5	1.25	7.5	8.4
175	5	10.25	5	4.5	5.75	6.3	227	5	6.25	4	13.75	8.5	9.8
176	5	8.25	5	3	5.25	5.8	228	5	11.75	5	3.75	8	8.7
177	5	0.5	4	11	5.5	6.8	229	5	1	4	12.75	4.25	5.2
178	6	1.25	5	12	5.25	5.4	230	6	10	6	2	8	7.5
179	5	5	4	15	6	7	231	6	0	5	10.25	5.75	5.8
180	6	1.25	5	12.25	5	5.1	232	6	6.75	6	1.5	5.25	5.1
181	4	14.5	4	11.25	3.25	4.3	233	5	2.25	4	15.75	2.5	3
182	6	3	5	12.5	6.5	6.5	234	4	12.75	4	7.75	5	6.5
183	6	13.25	6	6	7.25	6.6	235	5	15.25	5	12.25	3	3.1
184	6	2.5	5	11	7.5	7.6	236	5	13.5	5	6	7.5	8
185	5	12.5	5	4.75	7.75	8.3	237	7	0	6	8.75	7.25	6.5
186	5	7.5	5	3	4.5	5.1	238	6	3.75	5	15.75	4	4
187	6	0.5	5	8.25	8.25	8.5	239	7	7.25	6	14.75	8.5	7.1
188	5	11.25	5	6.25	5	5.4	240	5	1	4	12.5	4.5	5.5
189	7	14.75	7	6.25	8.5	6.7	241	4	5.25	4	1.5	3.75	5.4
190	7	3	6	9.5	9.5	8	242	4	3.75	4	1	2.75	4.1
191	5	15.75	5	9.25	6.5	6.7	243	3	13.25	3	11.25	2	3.3
192	6	3.25	5	10.5	6.75	6.8	244	3	15	3	12	3	4.8
193	6	11	6	2.25	8.75	8.1	245	5	4.75	5	2	2.75	3.2
194	4	12.5	4	9.25	3.25	4.2	246	5	0.25	4	14.75	1.5	1.8
195	6	2.75	6	0.75	2	2	247	5	0.75	4	14.5	2.25	2.8
196	4	14.25	4	7.75	6.5	8.3	248	5	0	4	12.75	3.25	4.1
197	5	2.75	4	14	4.75	5.7	249	4	13.75	4	9	4.75	6.1
198	4	10.5	4	5.75	4.75	6.4	250	5	6.5	5	2.25	4.25	4.9
199	5	11	5	8	3	3.3	251	5	4.5	4	15.5	5	5.9
200	5	1.5	4	12	5.5	6.7	252	4	10.5	4	8.25	2.25	3
201	5	0.5	4	12	4.5	5.6	253	3	11.25	3	9.25	2	3.5
202	6	11.5	6	4.25	7.25	6.7	254	4	15.5	4	11.75	3.75	4.7
203	5	13.25	5	5.75	7.5	8	255	4	2.5	3	13.5	5	7.5
204	5	1.25	4	11.75	5.5	6.7	256	4	15.75	4	11	4.75	5.9
205	5	0.25	4	10.75	5.5	6.8	257	4	12	4	8.25	3.75	4.9
206	4	12.5	4	5.75	6.75	8.8	258	4	2.5	4	0	2.5	3.7
207	5	12.5	5	7	5.5	5.9	259	3	15.5	3	13	2.5	3.9
208	4	14.5	4	9.5	5	6.4	260	5	0	4	12.5	3.5	4.3
209	6	8.25	5	15	9.25	8.8	261	5	0	4	10.75	5.25	6.5
210	5	4.75	4	15.5	5.25	6.2	262	4	0	3	13	3	4.6
211	6	10.5	6	4	6.5	6.1	263	6	3.25	5	11.5	7.75	7.8
212	6	2	5	12	6	6.1	264	6	7	6	1.5	5.5	5.4
213	6	3.75	5	13.75	6	6	265	5	6.25	5	1.5	4.75	5.5
214	5	9.5	4	15.25	10.25	11	266	5	2.5	4	13	5.5	6.6
215	5	14.25	5	6.5	7.75	3.4	267	5	3.5	4	13.75	5.75	6.8
216	6	0.25	5	13	3.25	3.4	268	5	9.5	5	3.5	6	6.7
217	5	10.25	5	5.5	4.75	5.1	269	5	1.5	4	12.5	5	6.1
218	5	12.25	5	3.25	9	9.7	270	4	10.75	4	6.75	4	5.3
219	4	15	4	8	7	8.8							

Measurements of Seals and of Green and Salt Sealskins Taken on St. Paul Island in July, 1912.

Serial No.	Animal.			Green skin.		Salt skin.		Serial No.	Animal.			Green skin.		Salt skin.	
	Length.	Width.	Mask.	Length.	Width.	Length.	Width.		Length.	Width.	Mask.	Length.	Width.	Length.	Width.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
26	41	33	4	29¼	20¾	33¼	22	35	41½	28	5	32	22½	35½	21½
27	37	29	4½	27¼	20¼	34½	22¼	36	38½	27	4¾	29¾	19½	31½	22½
28	45	28	3¾	32½	24½	38¼	23¾	37	42½	27	4½	33½	22¾	36½	23½
29	40	31½	4	33	22½	39	22½	38	42½	28½	4¾	34¼	22¾	40	24½
30	45½	26	4½	28	23½	35	23½	39	41½	29	5	28	21¼	34	23
31	43½	29½	4½	34	24¾	38½	26½	40	50	28	5½	32¼	21¼	37	22½
32	42½	28	4¾	31¼	22¼	36	23	41	44½	30	4½	35¾	22¼	43	23
33	46	29	5	32	22¾	35½	25	42	45	29½	5½	32	22	35¼	24¾
34	41½	28	4½	29½	23	34	24	43	43	30½	5½	29½	23½	34½	27½

MEASUREMENTS OF SEALS AND OF GREEN AND SALT SEALSKINS TAKEN ON ST. PAUL ISLAND IN JULY, 1912—Continued.

Serial No.	Animal.			Green skin.		Salt skin.	
	Length.	Width.	Mask.	Length.	Width.	Length.	Width.
	In.	In.	In.	In.	In.	In.	In.
44	43	24½	4	32½	21½	36½	22
45	47	27	4	35	22¾	39	26
46	43	23½	4½	34	21¼	41	23½
47	39½	26½	3¾	28¾	19¾	34½	22
48	40½	29½	3¼	33¼	20½	39¾	23½
49	45½	29	6½	32¼	22¼	37¼	22¼
50	45	28	6¼	34¼	21½	40½	25
51	45½	27½	5	34½	21½	36	23½
52	47	28	4¾	31½	24¾	38¼	24½
53	42	28½	4	31½	23¼	35¼	23¼
54	45	31	4¾	32¼	20¾	37½	22¼
55	45	26½	3¾	34¾	20	35½	23½
56	42½	26½	4¼	28½	23½	36¾	25¼
57	46½	30	5½	31¾	23¾	35¼	26½
58	41	28½	3¼	31½	22	41¼	21¼
59	46½	29	4	35	23¼	38	26½
60	41½	27½	3¾	30½	23½	38¾	22½
61	43	30	3½	32	19	37¾	22¾
62	46	30	3¾	30½	23¾	37	24½
63	47	30½	4½	29	23¼	35¼	22¾
64	49	30	3½	28	23	43	27
65	44	30	4½	33¼	24½	39	24½
66	48	28½	5¼	34	23	34½	24
67	45	31	3½	31¾	23½	38½	24½
68	44½	28	3¾	29½	23¼	34¾	23¾
69	45½	28½	5¼	29½	21½	36¾	21½
70	43	28½	3½	31½	22	35½	23½
71	45½	28½	4¼	35½	24	36	25½
72	47	30	4¾	33	20¼	40½	22
73	41½	28	5¼	28¾	22¼	33	24¾
74	43½	29½	3½	28¼	22½	34	24½
75	43	28½	5½	34	21½	40	22½
76	45½	29½	5	34¼	21	40	24½
77	45	27½	4¾	29½	23	35	25¼
78	46	30	5	35¼	22½	39	23
79	48	30½	4½	30	23	35	22
80	48	30	4½	31½	23½	40½	24½
81	43½	30½	5½	30	23¼	34½	24
82	42	30½	4¾	34¼	20½	40¾	23¾
83	44	28	4½	32¾	21½	39	22½
84	46	29	4¾	29	21	35¾	23¼
85	43½	29	3¾	33¾	20½	38¾	22½
86	47	31½	4	35¾	22	43	24
87	44½	31	4¾	34¾	21	40	24½
88	43	30	5	33	22¼	36	24
89	45½	27½	3¾	34¼	24¾	38	24
90	44	29	4	33¾	22¼	37½	23½
91	43	29	4	33½	21½	37	22½
92	45	28	5¼	33	23½	37½	25
93	47	27½	4⅛	32¼	25¼	37½	26½
94	48	30½	4¼	33	21¾	39½	23½
95	47½	30½	4¾	35¾	22¾	40¼	25¼
96	44½	27	4½	30	23	36	22½
97	47	32½	4¼	38	24¼	38½	25¾
98	48½	30	4¾	36	24	37½	26
99	44	31	3¾	31½	22¼	41	22½
100	42	30	4½	35	22½	39½	25¾
101	43½	31	5	31¼	22	32½	22¾
102	48	29	4¼	34½	22	38	23
103	46½	32½	3½	36¾	21	42	23½
104	47	29	4	34½	23½	39	23½
105	45½	33	3½	31¼	23	37¼	22¼
106	46	32½	3½	35	23¾	40¼	26½
107	47	29	4¼	36¾	20¾	41¼	26¼
108	47½	28½	4¾	34½	24	38¼	24½
109	49½	30	3¾	34¼	24½	39	24¼
110	44	29	4	32½	22¼	37	26
111	42	29½	4	32¼	21	38½	22
112	44½	29½	4¼	34	23½	37½	24½
113	45	31½	4	33½	24	35½	24¼
114	43	31½	4½	32¼	23	37¾	23¼
115	46½	30	4¾	34½	24¼	35½	27½
116	45½	29	5	31	22¾	34¼	22¼
117	44½	32	5	33	22	35½	24¾
118	47	30	3¾	34	24½	38½	26

Serial No.	Animal.			Green skin.		Salt skin.	
	Length.	Width.	Mask.	Length.	Width.	Length.	Width.
	In.	In.	In.	In.	In.	In.	In.
119	42½	29	5½	31½	22	36¾	22¼
120	44	29	3½	35¾	21¼	37	25
121	44	32	3¼	32	22½	38	24
122	48	30	4	33¼	24½	36	27
123	46	27½	4¼	33¾	20¼	40½	23
124	47	27	4¼	32¼	21	36	25½
125	49	29	5¾	36	24¼	42	27½
126	51	32½	5	35½	23	42½	25½
127	......	......	......	......	......	......	......
128	......	......	......	......	......	......	......
129	......	......	......	......	......	......	......
130	......	......	......	......	......	......	......
131	......	......	......	......	......	......	......
132	......	......	......	......	......	......	......
133	......	......	......	......	......	......	......
134	......	......	......	......	......	......	......
135	......	......	......	......	......	......	......
136	43½	28½	4¾	29¾	22	31½	23
137	44	27	5¾	28¾	21½	31½	24
138	42½	28	4	30½	21	31	23¾
139	47½	29	4¼	35	22½	35	25½
140	47½	32½	4¼	31½	24½	34½	25½
141	48	29½	4	29¼	21¼	30½	23¼
142	43½	29½	4¼	32¼	22	34	22½
143	44	30	5	27¾	23	29¼	24¾
144	44½	29	4	31½	22	35½	25½
145	46½	28½	3¾	30	24	34¼	24½
146	46	33½	3¾	33½	24	40½	25
147	47½	32½	4¼	30¾	22½	37½	23
148	45½	34½	3¾	35	25	41¼	26
149	44	31	5	33¼	20½	33½	25
150	44½	29	4¾	32	21½	34½	23
151	47½	28½	6½	32½	24	32¼	29
152	50½	32½	5¼	34¾	24	37	26½
153	51	33	4¼	35	25	41	24
154	48½	33½	5	29	26	33	26
155	46	31½	5	31½	23½	36½	26½
156	47	31	3½	38	21¼	40	25
157	47	30	5½	34	23	38	26½
158	45	25½	5	29½	21½	36¼	24
159	45	30½	4½	32½	23½	37	24
160	48½	28	4¾	32	24	33½	24
161	47	28	5¼	34	23	40¼	24¼
162	48	30	6	34	23½	39¾	24
163	44	28½	4¾	31	21	37¾	21¾
164	48½	30½	5	35	24¼	36½	27½
165	47½	29	5½	32	22	33	25
166	48½	30	5	33	22½	34½	23¾
167	44	31	4½	31¼	22	31¼	22¾
168	43	27	4½	29¼	21	33¼	22¼
169	42½	29½	4¼	31	23	37½	25¾
170	39½	27½	4¼	29	21½	33½	23
171	49	29½	4¼	38	23½	38	26
172	44	29	5	31¼	22½	34	22½
173	45	27½	5	30½	21½	35	25
174	46½	29½	4¾	30	22½	34½	25½
175	47	31½	5	31	23½	36	24¾
176	43½	29	5	33½	19	34	23
177	41½	28	4½	29½	23	32	25
178	45½	30	5¼	35	24	35	24½
179	43½	31½	4¼	33	21½	36	26½
180	43½	29	6¼	29	23½	35½	22½
181	38½	26½	4¼	29	22	33	23
182	45	32	4¾	30½	24	38¾	24½
183	44½	31	4	30½	22¾	33½	22½
184	46½	30½	4¼	32¼	23¼	36	25½
185	46	30	4¼	30½	22½	36	24¾
186	46	29½	3¾	33	23	38½	24¾
187	44	29½	3½	37	23½	38¼	24½
188	44	27	4¼	35	21½	35	26
189	49	33	5	28¾	28¾	34	28
190	46½	29½	4	33½	23	37	24¾
191	43½	26	4½	33	21	39½	22
192	45	29	4¼	31	23½	32	25½
193	47½	30½	3¾	34	23½	38½	26¾

MEASUREMENTS OF SEALS AND OF GREEN AND SALT SEALSKINS TAKEN ON ST. PAUL ISLAND IN JULY, 1912—Continued.

Serial No.	Animal.			Green skin.		Salt skin.		Serial No.	Animal.			Green skin.		Salt skin.	
	Length.	Width.	Mask.	Length.	Width.	Length.	Width.		Length.	Width.	Mask.	Length.	Width.	Length.	Width.
	In.	In.	In.	In.	In.	In.	In.		In.	In.	In.	In.	In.	In.	In.
194	48½	30	4¾	29	20½	33¼	23¼	217	45½	29	4¼	32	23½	36	25
195	49	32½	4¾	34	22½	38¼	25½	218	44½	30	3¾	32½	22½	36¾	23½
196	41	29½	4	31½	20½	35½	22½	219	46	26½	4	30¼	23¼	32½	26
197	47½	31½	3¾	31	21½	32	21¾	220	43½	30½	4¼	29	21½	37	25
198	42½	27½	4	29½	20	32¼	21½	221	48	32½	4½	31	25	35¾	23¼
199	42	31½	3¾	29½	25	35½	23½	222	46½	27½	3½	32	20½	32¼	22½
200	40	28	3¾	31	20	31	21	223	42½	28½	3¾	29½	22	38	22¼
201	41	28½	3¾	29	21	35¾	23	224	44½	30½	4	32½	22½	34	22½
202	46½	31	4½	33½	25	35½	25	225	39½	27½	3¾	29	21	38¼	23
203	47	26½	3½	31	22¼	31½	23½	226	46	31	4	33	24	36	22¾
204	40	28	3½	30½	22½	37¼	23	227	43½	30	4	33	21¼	38	23
205	43½	27	3½	29	23	34	25¾	228	43	27½	3¾	30	21¾	32½	23
206	44½	30	3¾	30¼	21¼	35	21½	229	43	26	3¾	31½	21	36	22¾
207	47	30½	3½	34½	23½	38	27	230	46½	29	3¾	32½	25¼	33	26½
208	44½	30½	4	29½	21	34¼	23¼	231	46	29½	3½	35½	22¾	39½	24½
209	47½	30½	4	36¾	21	38	24	232	47	30	3¾	33½	23½	38	25
210	44½	28½	4¼	31	24	34	24½	233	43½	30	4	30½	22	36¾	22½
211	44	28½	3¼	31½	22	38	26	234	42½	27	4	33	20½	32¼	23
212	46	28½	4	31½	23	34	23½	235	45½	27	3½	34	23	38½	26
213	44½	28	3¾	36	24¼	38	27	236	45	28	3¾	31½	25	38	26
214	39½	27½	4¼	29	21½	35	23½	237	43	29½	4	29¼	22¼	34½	26
215	43½	27	4	33½	22	36	23	238	38½	30½	3¼	31½	21	37½	23¼
216	43½	31½	3½	30½	23¼	35¼	24½	239	46½	28½	4	32	24	33	25

BRANDING FUR-SEAL PUPS.

In the summer of 1912 the foundation of an experiment was laid having for its object the determination of the question of the ages of seals and other related questions.

The law permits the killing of male seals of certain ages and prohibits the killing of others, but there is no mark, anatomical character, or other characteristic by means of which it can now be said that a certain seal is a 2-year-old, another a 3-year-old, and so on. Without placing upon the seal some distinguishing mark it is impossible to follow through its life from year to year. A certain seal may be observed in a certain place one year, but there is no known way by which that seal can be picked out from among the thousands that return the next year.

As a matter of fact, the only Alaska fur seals in the world whose ages are actually known (pups of the year excepted) are the three now in captivity in Washington.

The best judgment growing out of long experience has been and is used in dealing with these matters. Seals possessing a size within certain limits and showing certain characteristics of color, etc., are called yearlings, or 2-year-olds, or 3-year-olds, but it is not known they are what they are called; at best, judgment, opinion, or conjecture, not knowledge, has been relied upon.

A system of branding by which a permanent, distinguishable mark is placed on the seal would supply actual knowledge regarding this matter. Such a system was applied in the summer of 1912.

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Early in September Mr. George A. Clark and Mr. M. C. Marsh, with native helpers, branded 1,741 pups, male and female. Others were branded later and the total number for both islands brought up to 5,529.

The branding was done with a hot iron shaped like the letter T, and applied on the top of the head. The head was selected as the best place for the mark because it is the spot aimed at by the clubber, and the mark is to warn the clubber to save the animal bearing it. It is the best place for the brand also because the skull offers a firm base on which to work, superior to the yielding surface of the back.

The 5,529 pups branded this year, while not as large a number as was desired, will form a basis from which much valuable information may be expected. From those returning in 1913 a certain small number should be killed and careful measurements and weights taken both of the animals and their skins. The exact age of these animals will be known. The measurements and weights will establish a standard for the yearling. In the season of 1914 from the survivals of this body of branded seals a similar number will be killed, weighed, and measured. These animals will be definitely known to be 2-year-old seals, and the data furnished by them will fix the standard for that age of seals. Similar killings, weighings, and measurements will be made in 1915 and the standard for 3-year-olds established. Similarly the standards for other ages will be determined, and from the final survivors the breeding period and age limit can be learned.

ABSENCE OF DEAD PUPS.

The subject of natural mortality among the seal pups is discussed at length in the report of the naturalist, and also by Mr. George A. Clark.

In 1896, 11,000 dead pups were found on the breeding grounds, or 9 per cent of the total birth rate. As these were found early in the season before starvation from the killing of the mother seals by the pelagic sealers could have resulted, it was evident that this was not the cause. An examination of the dead pups also showed that they had not died of starvation, but that they had died from other causes, chiefly as a result of trampling in the overcrowded rookeries. Later in the season, after the effects of pelagic sealing began to show, fully 16,000 more dead pups were counted whose death was undoubtedly due to starvation.

In 1912, for the first time in many years, there was no pelagic sealing, and it was, therefore, with much interest that the rookeries were searched late in October for dead pups, with the result that not one starving pup nor one dead of starvation was found. Contrasting this with the conditions in 1896 and in other years when

pelagic sealing was carried on, and when thousands of pups which had died of starvation were observed, it is easy to believe that the herd will rapidly increase now that the great cause of its depletion has been removed.

CENSUS OF THE FUR-SEAL HERD.

In the season of 1912 it was possible for the first time in the history of the fur-seal herd to take a complete census of the various classes of seals present on the islands. This work was done by Mr. George A. Clark who, as secretary of the fur-seal commissions of 1896 and 1897, made the partial enumerations and estimates of those years, and who made also the approximate enumeration of 1909. Again, Mr. Clark spent the summer of 1912 upon the Pribilof Islands, devoting his entire time to a study of the fur-seal herd. The details of his work are set forth at length in his official report.

The census of the herd, as taken by Mr. Clark, shows seals of the various classes present as follows:

Active bulls, with harems (actual count)	1,358
Idle and young bulls (actual count)	312
Hauling ground bulls (actual count)	302
Branded reserve males (actual count)	2,000
Pups (actual count)	81,984
Breeding cows (equal in number to the pups)	81,984
Remaining nonbreeding seals (estimate)	48,000
Total	215,940

It is important to note that an actual count was made of all the active bulls, all the idle and young bulls, all the hauling ground bulls, all the 3-year-old males marked and reserved for breeders, and all the pups. And, as the number of breeding cows is the same as the number of pups, their number also was definitely determined. The only classes not actually counted or whose number was not definitely determined by the count of other classes were the yearling males, the yearling females, the 2-year-old males, the 2-year-old females, the 3-year-old males that were not branded, and an indefinite number of 4-year-old males. These were estimated at 48,000, which is probably an underestimate.

The seals embraced in the estimate of 48,000 nonbreeding seals include all the yearlings (both males and females), all the 2-year-olds (both males and females), all the 3-year-old males (excepting the 2,000 branded for reservation), of which there was a great number, as shown by the rejections in the drives. These classes, as shown by the counts and estimates of 1911 (which the more careful census of 1912 showed to be under rather than over the actual number), totaled 66,265. Deducting from this number 3,764 (the number

killed between August 10, 1911, and August 11, 1912) and allowing a natural mortality of 14,500 (which is excessive in the absence of pelagic sealing), we arrive at the 48,000 of Mr. Clark's estimate.

It therefore seems certain that the Alaska fur-seal herd at the end of the killing season of 1912 (August 10) numbered at least 215,940 seals of all ages, and the proportion of seals of the various classes shows it to be in an excellent condition.

MINOR FUR INDUSTRIES.

By Harry J. Christoffers, *Warden*.

and

Lee R. Dice, *Deputy Warden*,

SCOPE OF FIELD INVESTIGATIONS.

In order for the warden and deputy wardens to perform their duties intelligently it was necessary for them to make a study not only of trapping and trading methods and conditions, but of the general natural history of the regions visited, giving particular attention to the distribution, abundance, habits, enemies, and food of the various species of fur animals, and the relations to them of the birds and other animals found in the same regions.

Headquarters were maintained at Fairbanks and at Tanana, with a camp for a short time also on the Chena River about 30 miles above Fairbanks. In October, the Circle trail and the adjacent region was patrolled, as was also the Valdez trail, and a trip was made into the Mount Hayes-Delta country in November.

In the latter part of December and early January the early catch of foxes was brought into Fairbanks by traders and trappers of the surrounding region. During this time the warden gave most of his time to inspecting the furs and interviewing the men. An arrangement was made with the dealers whereby all persons bringing in furs were reported to the warden, who at once called on them for the purpose of inspecting the furs and acquainting them with the law and regulations. A few lots of unprime skins were found, the most important being eight early mink skins brought in by a prospector and trapper from the upper Kantishna. The skins were burned by the fur warden with the assistance of the trapper. As this was his first trapping experience, and as he had not been in from the hills for three years, he was let off with this and a warning. He promised not to begin trapping hereafter until the open season.

In February a trip was made into the region south of the Tanana River. This region proved to be continuous swamp land, a large part of which had been burned over recently. As a result the only fur animals seen were a few rabbits.

Upon returning to Fairbanks a trip was planned to the headwaters of the Chena, thence across to the Goodpaster River and to Lake Washburn, where it was intended to make extended investigations,

but instructions received from the Bureau to keep expenses as low as possible made it necessary to abandon this and all other important work involving any considerable expense. All that could be done was to make short daily trips into the surrounding country. Although this was unfortunate, the time was not wholly wasted, as it gave an opportunity to see the spring skins brought into Fairbanks from many regions.

The deputy warden in charge at the Tanana headquarters left that point in February and established a camp at the headwaters of the Kuskokwim River, remaining until June, when he made a trip down the river to Bethel, thence to Russian Mission, St. Michael, and Nome, where he arrived the end of September. Meantime, starting in July, the Fairbanks party traveled down the Tanana and the Yukon to St. Michael and thence to Nome, making stops wherever possible to acquaint the traders and others with the fur law and regulations and to gain a knowledge of conditions in that country. The visits to St. Michael and Nome were particularly important because of the prominence of those places as shipping points for raw furs.

NATURAL FEATURES OF INTERIOR ALASKA.

The interior of Alaska, north of the Alaska range, shows, in general, broad, nearly level valleys and massive rounded hills, rising in many cases above the timber line into high, isolated domes. Northeast of Tanana these bald domes form an extensive range and in some instances rise to the height of over 5,000 feet.

The Mount Hayes district is the source of many small streams which ultimately empty into the Tanana River. This district is composed of a continuous range of mountains and high, bald hills. Near the mountains there are high plateaus, miles in extent, forming an admirable feeding ground for caribou. The Tanana near Salchaket begins to widen out for about 100 miles into the broad Tanana Flats, wherein are many islands. Near its confluence with the Yukon it widens again and from Tanana down the Yukon itself is much wider than the upper Yukon.

The Yukon country from Tanana to Andreafski is very uniform in character. The southern side of the river is mostly a low, level country, while the northern side for miles consists of continuous high hills, mostly heavily forested with white and black spruce, birch, and cottonwood. Below Holy Cross the hills are not as numerous, and from Anvik down there are a great many islands covered with impenetrable willow thickets. Near Andreafski the tundra region begins and the country becomes low and very level.

The North Fork of the Kuskokwim rises among the hills north of Lake Minchumina. Most of these hills are low, but a few domes rise to altitudes of about 3,500 feet. One of these is Mount Sischoo,

which rises between the Kuskokwim and the Novi drainage systems. The stream until the junction with the McKinley Fork is clear and very sluggish and winding. The McKinley Fork is a swift glacier stream carrying much mud in suspension, and from this point on the Kuskokwim is muddy. With the union of the East and South Forks the river becomes of large size and moves with increasing velocity toward the sea. Many small lakes occur in the broad valley of the river and these are especially abundant on the upper part of the river. No hills of any size are touched by the river till the neighborhood of Georgetown is reached. The valley is forested with the same forest typical of the Yukon Valley—that is, black spruce forest with white spruce and birch along streams and on favorable hillsides. Below Akiak the valley spreads out to join with the Yukon in forming the Kuskokwim-Yukon delta.

The region along the Yukon and Kuskokwim Rivers and their tributaries is in general rather heavily forested. The larger unforested areas are the tundra along Bering Sea and the portions of the hills above timber line in the interior. Along the rivers there is commonly a mixed forest of white spruce, white birch cottonwood, alder, and willow. This forest forms a narrow strip along the rivers and small streams, and often extends for a considerable distance up the ravines. On favorable south slopes it may extend over the lower hills, even up to timber line.

The vast forests which cover the low hills and the greater part of the valleys of the interior are composed mainly of black spruce. The trees are mostly a stunted form growing from 6 to 20 feet high and with trunks from 1 to 4 inches in diameter. The forest is not, as a rule, very dense, so that a person can easily walk between the trees. The ground is usually heavily covered with moss, and shrubs of various kinds grow in the available space. These shrubs are principally Labrador tea, dwarf birch and willow, raspberries, blueberries, and currants. A species of larch recently described as new, under the name *Larix alaskensis* Wight, occurs frequently and seems to grow between the black spruce and stream forest or mixed in the black spruce forest in damp situations. It does not flourish, however, and appears to be soon crowded out by the spruce. The trunk reaches a maximum diameter of 10 inches at 2 feet above the ground. In favorable situations the black spruce may reach a diameter of 12 inches, while white spruce are often found with a diameter of 24 inches.

On the Big Chena and upper Tanana there were formerly a great many large white spruce, but on the former especially they have been much cut for sawmills.

The hills above timber line are covered, except in very rocky situations, with moss, grass, and low shrubs. Moss in which is

scattered the lichen, "reindeer moss," is the predominating feature, but considerable meadows of grass occur. Dwarf willows are found extensively in the ravines and protected coves far above timber line. Scrub alders also often form dense thickets above timber line and occur sometimes as a fringe above the white spruce and birch forest where this reaches the tree line. In many places dwarf birch and blueberries are found abundantly in large patches a short distance above the limit of trees.

The larger rivers form in various portions extensive mud or sand bars which at first become covered with equisetum. A few years later willows appear and they in turn give way to alders. Finally cottonwoods succeed the willows and alders only to be crowded out by the white birch and white spruce forest. If sufficient time be given the formation the white spruce finally becomes the dominant tree. In the shade of the stream forests a few grasses grow in places, and if the shade is not too heavy, bushes of cranberry, raspberry, or currant may cover the ground. Dwarf alders may also persist, but outside of these there are few other shrubs.

On the south hill slopes bordering Lake Minchumina an extensive white-birch forest is found. The trees of this forest are very uniform in size and height, being from 6 to 12 inches in diameter and about 50 feet in height, with no large branches till near the top. A few red birches and young white spruce are also found. The forest floor is covered with low cranberry bushes, other shrubs being nearly absent. No pure birch forest of this extent was seen elsewhere.

In the change from a lake to a swamp and finally to land trees do not gain a foothold until several other stages have been passed through. Around a typical lake of the interior there is, first, a fringe of equisetum extending into the water until it has reached a depth of about a foot; next comes a fringe of sedges which may start at the very edge of the water; then, in order, on the drained ground comes a strip of grass and finally willows, alders, cottonwoods, and the forest of white spruce and white birch. Within the lake itself there are large patches of water lilies. In the black-spruce forest there is another form of lake border in which sphagnum moss grows directly to the water's edge and there is little or no grass, sedge, or equisetum about the lake.

In the level parts of the valleys and on some of the high plateaus extensive formations of niggerheads occur. The niggerheads are formed by the growth of thick, tough clumps of grasses, which elongate each year until the head is several feet above the ground. As the tops grow very close together it is almost impossible to travel through a country composed of high niggerheads. These grasses are often found in black-spruce formations with the spaces between the heads filled with moss. As the niggerhead formation often changes

gradually into the black-spruce formation it appears to be merely a local variation of the latter.

Extensive patches of blueberries occur in the slightly timbered areas in the valleys over the entire interior. These areas are as a rule covered with moss and a few black-spruce trees occur. Blueberries, raspberries, currants, and rose haws form a considerable part of the diet of certain birds and animals throughout the fall and early winter.

Along the Bering Sea coast typical tundra formation is found. This consists of a form of niggerhead grass in which blueberry bushes are often common. Near the rivers the tundra is crossed by many small streams, sloughs, and ponds which make travel almost impossible during the summer. The tundra reaches a short distance east of Andreafski, on the Yukon, and Bethel, on the Kuskokwim. A few willows are found in favorable places a short distance below these points. Between the two rivers the tundra extends much farther eastward, being found on the Kuskokwim-Yukon portage.

This somewhat full description of the forest conditions prevailing in the various regions visited is given because they are so largely the determining factors in the distribution and abundance of the fur-bearing animals.

TRAPPING AND HUNTING GROUNDS.

One can not fail to be impressed by the comparative scarcity of birds and mammals in the interior of Alaska, not only in the number of species but also in the number of individuals, in proportion to the expanse of uninhabited country. During the migrating periods large flocks of birds are often found, but they are the product of a large area of country. In certain localities colonies of small mammals can be found, but these localities are few. One may often walk for hours in seemingly favorable districts without encountering a single species of vertebrate life. In general, the individuals in any given region are few in number and are thinly distributed.

It has been stated by previous writers that the fur trade in the interior of Alaska has dwindled to insignificance. Yet the shipments of fur from Alaska during the fur year from November 15, 1911, to November 15, 1912, were far in excess of the purchases of the old Russian-American country for any single year. The fur trade to-day is, however, divided among a large number of dealers, and thus appears to be very small. The fur animals are extremely scarce in comparison to their abundance of a few years ago. The high price which the various skins now command has caused the animals to be hunted more assiduously than ever before, and as a result the total output is relatively high.

THE FAIRBANKS DISTRICT.

The Fairbanks fur-bearing district covers a very large territory. Around Fairbanks proper no real trapping can be done. Fairbanks itself is quite a large town, and its mining district runs out for many miles over "the creeks." Where considerable mining and prospecting has been carried on for a term of years the fur bearers have been exterminated.

Fairbanks is situated on the Chena Slough, about 4 miles across country from the Tanana River. Going up the Chena Slough about 15 miles, we strike the Chena River, a clear-water stream. Even on the river about 50 miles up a potato farm is found, and farms are also found in several places fronting the Tanana. No good trapping grounds can, therefore, be found nearer than 150 to 200 miles from the city. South of the city and the Tanana River occur miles of continuous swamp, in which no trapping can be carried on. Good trapping grounds are, therefore, found only long distances from Fairbanks. The best regions are the headwaters of the Chena River, which empties into the Tanana at Chena; headwaters of the Salcha, emptying into the Tanana at Salchaket; headwaters of the Goodpaster to the Volkmar River and the Healy River. The Chatanika, emptying into the Tanana at Tolovana, has good mink-trapping grounds, and the Kantishna and Nenana, with their tributaries, have at different points good grounds for several species—mink, marten, fox, and lynx. The streams above mentioned are all clear-water streams.

The Tanana River itself is a very muddy glacial river. The water is very cold and swift. A good swimmer can keep up in the water only a short time, as it is so cold that cramps set in. To fall overboard invariably means to drown. The river is hardly navigable above Chena, being in places 1 or 2 miles wide and full of flats.

The post farthest up the headwater of the Tanana, Newton's trading post, is near the mouth of the Healy River. The same trader has run this post for a number of years. He has a large Indian trade. Formerly he obtained a large number of fox and beaver. Fox were destroyed by poison several years ago and are now seldom obtained. Beaver were also nearly extinct before the close season was established. The main fur which he obtains is mink and marten, more of the former. Both species have in the district a good dark color. This dealer ships his furs from or sells them in Fairbanks.

The Salchaket trading post, at the mouth (ket) of the Salcha River, is owned by a trader who has been there for a number of years. The Salchaket Indians, with whom he has the larger trade, are a very industrious, clean class of natives, as Indians go. They do a

great deal of hunting and formerly a large amount of trapping. Since the establishment of this mission, however, they hardly ever go trapping until February. Mink and marten are about the only furs purchased. The marten are of a very good quality, but the mink are too often a dark brown, somewhat lighter than the average dark-chocolate mink of the interior. This is not due to any fault in the mink, but to the fact that the Indians do most of their trapping after the first of the year. This trader has a winter post office, but sends most of his furs to Fairbanks.

At Chena furs are seldom sold. Trappers prefer to take their catch to Fairbanks, where there is more competition.

The Nenana trading post and post office is run by a trader who ships most of his furs by mail. He gets nearly all the Nenana Indian catch and a large number of white-trapper furs from the Kantishna and Nenana rivers. The rest of these furs go to Fairbanks As these rivers run through a varied country from the high mountains of the Alaska range to the lower swamp lands near the mouth, a varied collection of skins is obtained. The middle country between the Nenana and the Kantishna is a good lynx country. The trader at Nenana obtains from 50 to 100 a year. The vari-colored martens from the upper Kantishna and the darker-colored ones from the Nenana are brought here. The mink are of a good quality, and several hundred are brought in each year. The Nenana Indians catch a great many muskrats, which are plentiful near the mouth of the river, and may be obtained without much exertion. Foxes were quite common toward the Alaskan range, but are now not so common.

The Tolovana trading post, at the mouth of the Chatanika, is run by two traders. A large number of mink and muskrat are obtained by the Indians here, also a few lynx and fox. The country is mostly low, covered with spruce forests, though farther up the Chatanika it becomes quite hilly. Most of the fur obtained is sent to the Fairbanks store of this company.

Though the country around Fairbanks has long ago been trapped out, more furs are handled there probably than in any other place in the interior of Alaska. Competition is very strong, so it is with credit to themselves that the reliable dealers refuse to buy a collection containing unprime skins. Trappers, and some traders, come here from far distant points to dispose of their winter furs. The best of the furs purchased here are sold locally at high prices.

There are several dealers in furs at Fairbanks. Individuals also often buy small lots, pick out a few of the best skins, and ship the others. One firm handles the largest proportion of goods purchased directly in Fairbanks. They make a practice of picking out and selling in sets locally the best-matched skins. In this way they can get about one-

third more than by shipping them to the States. A large number of small shipments to furriers will thus have come directly from this company. Mink, marten, and ermine are the principal furs handled by them. In sets the following prices were obtained on an average during the past season: Mink, $7 to $8; marten, $13 to $15; ermine, $1.50 to $1.75. The price on ermine was above value owing to the large local demand; $1.25 to $1.75 being all an extra good bunch is worth in the States. Below is an estimate of the number of the skins purchased by a company at Fairbanks the past season and the average prices per skin:

FURS PURCHASED BY ONE DEALER AT FAIRBANKS, SEASON OF 1911–12, WITH AVERAGE PRICES PAID THEN AND IN 1910–11.

Species.	Number.	Average prices paid 1911–12.	Average prices paid 1910–11.
Marten	600	$9.00	$7.00
Mink	700	5.00	3.50
Ermine	350	1.15	.50
Fox, red	20	8.50	7.00
Fox, cross	15	12.50	8.00
Wolverine	15	6.00	5.00
Otter	3	10.00	
Wolf	1	6.00	
Lynx	30	22.00	18.00

This table shows the considerable increase in the prices paid in 1911–12 over those of 1910–11.

There are several other buyers at Fairbanks, each of whom buys about the same quantity as the one whose figures are given in the above table.

Several extra fine skins were brought into Fairbanks during the past season, among them being two very dark and unusually beautiful marten that sold for $100 and three beautifully matched silver-gray fox skins brought in by a prospector. These were shipped to London, where they brought $600 each.

TANANA DISTRICT.

The region about the mouth of the Tanana is rather low and full of small streams. Back some distance from Tanana the country consists chiefly of low hills with small valleys and streams between.

No large quantity of fur is obtained near the post itself; most of the fur brought in to Tanana comes from points 40 to 50 miles distant. Near by, however, in the many sloughs about the mouth of the Tanana, considerable numbers of muskrat are trapped or shot. A good many mink also are obtained. Marten are brought in from the hilly country.

As there are no important trading posts along the Porcupine and Chandlar Rivers (which join the Yukon near Fort Yukon), consid-

erable quantities of furs are brought down to Tanana from that region as well as from Fort Yukon and Rampart. Still greater quantities come in from the Tozitna and upper Melozitna Rivers. The total quantity of furs brought to Tanana in 1911–12 was greater than in the previous year. The high prices paid induced more trappers to go out and to trap more energetically.

There are at Tanana three principal buyers of furs. The business is increasing and good prices are paid, but almost invariably in trade.

A large proportion of all the fur animals of the interior of Alaska are represented among the furs brought in to Tanana. The most abundant is the muskrat; the most important are mink and marten, most of the latter being pale in color and not so valuable as the darker-colored individuals, a few of which are seen. Even a few white fox were brought in from the upper Melozitna. Beaver are found in the small streams and ponds. The law protecting them until 1918 is generally observed. Reports were current that one or more companies had bought some beaver, but they could not be verified. It is probable, however, that a few are killed by the Indians for food. A few fox and lynx are brought in from the Yukon hills.

The number of furs of each kind bought in 1910–11 and 1911–12 by one principal company at Tanana was as follows: Muskrat, 1,500 to 2,500; marten, 500 to 700; mink, 300 to 400; ermine, 100; lynx, 10 to 15; black bear, 11; cross fox, 10; red fox, 25; land otter, 10; white fox, 2.

RAMPART.

Rampart has recently become a fur-buying post of some importance. It shares with Tanana and Fort Yukon the catch from the Porcupine and the Chandlar Rivers. It is in a good mink region. Considerable mining is carried on, and as the country is not old enough to have been thoroughly trapped out, the prospectors and miners are able to obtain a good many furs during their idle winter months.

FORT YUKON DISTRICT.

Fort Yukon is an important trading point for the large settlement of Indians located there and on the Porcupine and Chandlar Rivers. There is an Episcopal mission at Fort Yukon and the Hudson Bay Co. formerly had a post there.

The principal local trader reports that the quantity of furs handled there now is about as great as at any time in the past. The most important species are mink and marten; those coming from the Porcupine and Chandlar Rivers are said to be the largest, darkest, and most heavily furred to be found anywhere in Alaska. Lynx formerly constituted a very large part of the catch; a large number are still obtained, though it is claimed that a few years ago the lynx

suffered an unusual mortality from some unknown disease and that the species has not yet regained its former abundance.

KOKRINES.

This place, situated on the Yukon about 75 miles below Tanana, was formerly an important Russian trading post. Later it was continued by the man whose name it now bears and still later by the Northern Commercial Co. In the winter of 1911–12 the store burned and has not been rebuilt. It is understood that other stores have been established.

The Melozitna, coming down from the high Yukon hills and entering the Yukon below Kokrines, flows through an excellent trapping region, especialy for marten, mink, and otter. A new mining camp called Ruby has recently been established a short distance below Kokrines, and if this camp remains the furs of the region will probably go there.

KOYUKUK.

This place is on the Yukon at the mouth of the Koyukuk River and perhaps 100 miles below Kokrines. It is an unimportant place, consisting of a small trading post and a telegraph station. The region round about is low, somewhat hilly, covered with spruce, and is a good country for mink and muskrat, and marten and foxes farther back in the hills. It is a fair trapping region and apt to remain so for some time. Some black bear are found near Koyukuk in the Yukon hills.

NULATO.

Nulato is situated on the Yukon a short distance below Koyukuk, and is a small Indian village with a few whites. The Indians mostly have some Russian blood and are of a somewhat higher class than usual. There are two stores here.

The wooded hills and valleys about Nulato constitute an excellent mink and marten country. Muskrat are also abundant. A few red foxes come from the Koyukuk, but there are no white foxes or wolves. Lynx are not uncommon, one white man having snared 16 during the past winter.

The local traders this season handled about 2,000 muskrat, 800 mink worth $3.50 to $4.50 each, 400 marten worth $6 to $8 each, a few ermine caught chiefly by the squaws, 16 lynx, and a few foxes.

About 40 miles below Nulato is Kaltag, a small trading post with one store and a telegraph station. The country is like that about Nulato, very hilly, full of gulches and small streams, and covered with a continuous forest of spruce and birch.

ANVIK.

At the mouth of the Anvik River, about 200 miles below Nulato, is the Anvik Episcopal mission. There is here a considerable settlement of Indians who hunt and trap up the river and a short distance in the adjacent country, catching mostly mink, foxes, and marten. There is one small trading company which buys their catch.

HOLY CROSS.

Holy Cross, formerly called Koserefsky, a Catholic mission, one of the largest on the Yukon, is about 50 miles below Anvik and near the mouth of the Innoko River. There is here a considerable settlement of Indians, mostly half-breeds. There is one store, owned by the mission, also a school conducted by the mission.

The country, so far as adaptability to fur animals is concerned, is similar to that about Anvik. Directly across the river from Holy Cross the Shageluck slough empties into the Yukon. Although in the forested region, the country is flat and suitable for mink and muskrat. There are several small Indian settlements at different points on the slough, and several small traders have located among them. Some little distance from the mission beaver occur in considerable numbers, but the mission authorities do not permit them to be killed except rarely for food. Mink, marten, muskrat, and otter are the principal furs obtained.

About 40 miles below Holy Cross is a Russian post where there is a single trader, and 20 miles farther down is another.

This region is the beginning of the treeless zone. Marten and other arboreal species are therefore not present. The principal species are muskrat, mink, and foxes. The last trader referred to obtains annually 200 to 300 foxes, 600 to 700 mink, and a larger number of muskrats.

ANDREAFSKI.

This is a small post of no great importance, situated on the Yukon at the mouth of a small river of the same name. There is one trading company here.

Andreafski is in the treeless tundra region. No trees are to be seen anywhere, only the wide expanse of grass-covered tundra, full of sloughs and ponds, extending to the mouth of the Yukon and northward to Norton Sound.

The only natives of this region are Eskimos, the dividing line between them and the Indians being just below Holy Cross. The Eskimos are a better class than the Indians, being cleaner, more industrious, and more thrifty.

The muskrat is the most abundant fur animal in the tundra region. Red foxes are common and an occasional white fox is seen. The Eskimos are the only trappers in the region, and as a consequence

there has been no special decrease in the abundance of any of the fur animals.

ST. MICHAEL.

This important place is located on St. Michael Island, Norton Sound, about 60 miles above or east of the mouth of the Yukon. The island is a military reservation and the mercantile and transportation companies doing business there operate under permits issued by the War Department. The Northern Navigation Co. maintains headquarters at this place, where all passengers and freight must transfer to river boats. Some four or five other companies maintain stations there, each keeping a small stock of furs for sale to travelers.

On the island itself there are practically no fur animals, only an occasional muskrat or mink being seen. Many furs, however, are shipped from St. Michael by buyers who collect them as they come down the river in the spring immediately after the ice has gone out. People from all over the Yukon tundra section also come here, bringing in their catch of furs, which they ship or sell to local traders, receiving supplies in return.

NOME.

Nome, situated on the bleak, barren south coast of Seward Peninsula, would be unimportant with respect to furs were it not for the fact that schooners trading on both coasts of Bering Sea bring large quantities of white-fox and other furs to this place. Some lower Yukon traders also take their furs to Nome, where they exchange them for supplies.

In the summer a great many Eskimo congregate at Nome, coming with their families in their boats from all over the Seward Peninsula and from as far north as Cape Prince of Wales and the Arctic coast. They bring ivory, which they carve into various forms and trade to the local merchants or sell to the summer population. They also bring in the catch of white-fox skins, which they sell or barter. In the early fall, having obtained their winter supplies, they return to their villages.

The Bering Sea Co., of New York, which has done a general trading business at Nome for several years, has recently established stations at Point Hope and Point Barrow, at the former of which it does a large business in white foxes and ivory.

The various dealers at Nome handle white foxes, also mink and marten from the Yukon. One store had on hand about 200 white foxes, 150 mink, and 100 marten. The mink and marten came from the Yukon. It was stated that the white foxes were all brought from Siberia by whalers.

The United States Mercantile Co. has a store at Nome, but obtains its furs chiefly from two posts on the Kuskokwim. Two other trading companies obtain some furs in trade.

KUSKOKWIM DISTRICT.

About the headwaters of the Kuskokwim is a good marten country, and the animals taken there are of superior color. About the lakes and along the small streams and sloughs mink are found in some numbers. Otter are found in the same situations and about larger streams also. Black bear are quite numerous. Muskrats are common about the sloughs and other quiet waters. On the small streams and creeks beaver are abundant. Lynx and red foxes are occasionally taken, while wolverine and wolves occur along the Alaska Range. These conditions hold down the Kuskokwim as far as Georgetown. Below that point marten are rare, but mink, otter, and muskrat continue. When the tundra is reached the conditions have entirely changed. At Bethel the principal fur animals are the mink (the coast species different from the one found at the headwaters and less valuable), muskrat, and otter, the last quite rare. The Arctic hare is usually abundant and of some commercial value. The white fox is found principally on the islands off the coast.

Trapping in this region is done almost entirely by the natives. As a rule the sentiment of trappers and traders is favorable to the protection of the fur animals and the regulations are well observed. Numerous complaints were heard that the Indians kill mink, muskrat, and beaver out of season, but this practice is becoming less prevalent.

Competition among traders has been so keen that some have been induced to buy considerable numbers of unprime skins. They prefer, however, not to handle such skins, and many are now refusing to do so. The fur regulations are, in the main, applicable to this district and satisfactory to trappers and traders. Some think the open season for marten should begin November 1, two weeks earlier. Although the pelt may be prime by that date the fur is short and the skin has not yet reached its full value.

It was felt that the open season for the muskrat should be extended to June 1, and this has been done. This is desirable because muskrats are usually taken by shooting them in the water and that can not be done until after the ice goes out, which does not occur until the first or second week in May.

The black bear is so destructive to caches that no one thinks it should receive any protection.

Forest fires which occur often in this region are very destructive to fur and game animals, driving away those that are not killed. A burnt-over region reforests very slowly, and the fur and game animals are even slower to return.

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NOTES ON FUR-BEARING ANIMALS OF ALASKA.

MINK (TENA INDIAN NAME, "TARKUDZA" OR "TARBASHA").

Although the interior of Alaska has been trapped and retrapped for many years, mink are still quite common in and about many of the clear-water streams, and are perhaps the most important of the minor fur-bearing animals. Most of the larger streams, on account of their glacial origin, are usually quite muddy, and mink do not frequent them. The best mink region in the interior is that drained by the Porcupine and Chandlar Rivers, northwest, north, and northeast of Fort Yukon, and the Kantishna region south of Tanana. The lower Yukon tundra region is also good for mink, which are also common on the tributaries of the Koyukuk, though not much trapping has as yet been done in that region because of the unusual expense involved.

Skins from the interior of Alaska are usually dark chocolate in color; those from the tundra region are usually reddish brown, though a few of the one color may be found in the territory of the other.

The fur in the interior begins to become prime about the last of October, and by the middle of November most of the animals will have prime fur. However, even as late as November 15, an occasional animal will have an unprime skin. December skins are the best, the fur being heavier and darker than earlier or later. Spring skins never have the fur or desirable color that fall skins have. Late in March the fur begins to bleach and the fresh glossy appearance fades. By April 15 the guard hairs begin to fall out, the underparts become worn, and the fur becomes thinner. Continued cold weather and higher latitude or altitude will, of course, prolong the period of primeness.

Continuous and deep snows interfere seriously with trapping in December, at the very time when the furs are at their best. Trapping is then very difficult, the traps frequently becoming frozen up, covered with snow and lost. But the energetic, resourceful trapper who can endure the hardships of the rigorous climate, and keep in touch with his traps, is quite sure to make profitable catches of high-grade furs.

For mink the trapper sets his traps along the smaller streams, for it is there that the mink wander in search of small fish of which they are particularly fond. The mink may be taken either on the land or in the water. Experts usually prefer to take them on the land. The trap is set on a projecting point of the bank, or in the water at places where signs indicate that the mink come for fishing.

The mink wanders far afield. He will wander all along the banks of a stream or pond, explore every nook and corner, and all the little brooks and ditches emptying into larger streams. Traps are therefore often set on fallen trees and on logs across small streams.

Bait is sometimes used. The entrails of a bird or other animal make better bait than the whole animal, and fish oil or decayed fish is still better. A live bird is excellent; rarely will the mink pass without stopping to kill the bird.

Mink houses are often built as a protection to the trap and to lead the mink to the trap. The house is built of small pieces of wood or stone, the bait is put at the farther end and the trap in the entrance. This is regarded as a very good method. It protects the trap from freezing, but takes too much time if one has a long line of traps. Every trapper, however, has his own favorite method as the only really good one, and the methods are therefore nearly as numerous as the trappers themselves. Deadfalls are sometimes used in trapping mink but this method is not now much practiced. Steel traps, no. 1 and 1½, are now most used, even by Indians. The Indian uses but few traps, while the white man will have 100 to 200.

Albinism among mink is not uncommon; at least three examples have been noted recently. All were unusually large animals, one being 25 inches long when cased. The fur of these albinos was pure white, but the guard hairs were creamy white, thus marring somewhat the beauty of the skin.

Mink are said to prey on muskrats at times, and the entrails of muskrats are often used as bait. The principal food of the mink is probably fish, though the menu is by no means so limited. In one instance a quantity of grass and weeds and the remains of a squirrel were found in a mink's stomach.

Less than 10 years ago mink skins could be purchased in Alaska for one to two dollars. The average price now paid for the interior mink is $4.50 to $5.50, while many lots bring as much as $7 per skin. One lot of 107 skins taken in the Kantishna region by one trapper brought him $725.

There are, of course, not nearly as many mink in Alaska as formerly, but the high price which their pelts bring causes them to be hunted assiduously and a large annual catch is maintained.

MARTEN (TENA INDIAN NAME, "SUKA").

The marten is one of the most valuable of the fur-bearing animals of Alaska. It is an animal of the forest and is rarely seen where there are no trees. Of the regions covered by our investigations, the most important having marten are the Porcupine and Chandlar territory, the Kantishna, and the headwaters of the Kuskokwim.

The fur from the different regions has distinctive peculiarities. An expert can usually tell the locality from which any particular bunch of skins came. Those from the Porcupine country have very thick long fur, somewhat coarser than from farther south,

and brown in color. Skins from tributaries of the upper Tanana are dark chocolate brown, with shorter, finer fur. Those from the upper Kantishna and over the wooded hills to the Kuskokwim have peculiarly variegated fur seldom seen in other districts. They have in the same pelt almost every shade of orange and brown. It is only now and then that a marten with a "true-color" skin is caught in this region, and even these are rather pale. As a result the skins from this region have to be dyed.

The so-called black marten is a myth. The darkest ever seen are not black but a rich deep chocolate brown. Marten vary perhaps more in color than any other fur and the pelts are therefore hard to match, which fact, of course, adds to the cost of well-matched skins. There are a few very dark marten, a larger number of dark brown, and a much larger number that are pale in color, varying from light brown to golden yellow. Now and then a "golden" marten is found; these, however, are very rare and bring a high price. They are really more orange than golden. The only parts of the coat that do not vary greatly in color are the orange patch under the throat and the long bushy tail, which is blackish or dark brown.

The habits of marten are peculiar. They do not follow the small streams and ponds as do the mink and some other species, but prefer the higher land covered with heavy spruce or pine forests. In such regions the marten is almost the only fur animal to be found, and as a result the marten trapper is a specialist who traps for that one species.

The fur of the marten in the regions mentioned becomes prime early in November. It continues to improve, growing longer and heavier. By November 15 it is quite heavy and the skins are in good condition. The best pelts, however, are not obtained until December and the first half of January, when the fur is heavier, softer, and more glossy than at any other time. Very few furs can be taken at this season, however, because of the unfavorable climatic conditions. White men will sometimes venture out and do some trapping, but the Indians seldom go out before February or March.

It is claimed that the marten disappear periodically and with some regularity from the regions they frequent. They are not found dead and there is no evidence of migration. Perhaps it may be that food is unusually abundant and the marten are not tempted to avail themselves of the food supplied by the baited trap.

Marten are usually taken in steel traps, no. 1½ being the size preferred. The traps are set in hollow logs or trees, or sometimes near trees where their tracks have been seen, fish oil, fresh meat, or, better, rotten heads of birds being often used as bait. Marten, as a rule, are not very suspicious and no great care needs to be taken in setting the traps. They may be taken even in deadfalls or figure-four traps, but those methods are not much followed now.

Marten are much more rare than mink in Alaska; probably there are not more than one-third as many. Marten pelts are worth $9 to $10, and some bring as much as $30 to $40. Two perfectly matched dark marten caught last winter on Healy River brought the trapper only $40, although they were soon resold for $110.

The marten, although in the wild state apparently quite ferocious and untamable, as a matter of fact lends itself readily to domestication. It is more easily domesticated than almost any other of the fur-bearing animals. When taken young, it soon becomes quite tame and it is believed could be handled with commercial success on a fur farm.

ERMINE.

The ermine, or weasel, is found throughout the whole wooded interior of Alaska. It is found not only in the dense forests, but it is also quite common sometimes about miners' and woodchoppers' cabins, woodpiles, and in rubbish piles along the trails.

The female is much smaller than the male. She makes her home under a pile of stumps or stones or in a hollow tree. The young are born in May while the female is still white or only changing. The male and female do not remain together, but separate soon after the rutting season is over and lead solitary lives during most of the year.

By the middle of October most of the weasels have changed their brown summer pelage for the white winter coat and are then called ermine. A specimen (a male about 2 years old), taken on October 15 near Fairbanks, had not quite completed the change; the head and tail were mostly brown, the back was about half and half, while the belly was pure white. Four days later another male, several years old, was obtained that was entirely white; not a brown hair was to be seen; the skin inside was clear white or fully prime. It may be that the older animals make the change from summer to winter pelage sooner than the younger ones. In the spring brown hairs begin to appear early in April if the spring be an open one; usually, however, the change does not begin until after the middle of April. By the middle or last of May the change is complete and the coat is brown once more.

Ermine eat all sorts of small animals and birds, ranging in size from shrews and mice to rabbits and squirrels, and from chicadees to partridges. They feed chiefly, however, upon the smaller mammals and birds.

Because of the small size of ermine and the small price usually brought by the skin, trappers rarely make any special effort to trap it. The price is now increasing so rapidly, however, that the ermine is becoming an animal worth while, and trappers are paying more attention to it. Choice bunches of skins bring as high as $1.50 per skin, though the usual price for interior skins is $1.25 to $1.35.

BEAR (TENA INDIAN NAME FOR BLACK BEAR, "SES"; FOR BROWN BEAR, "TLARUZA").

Bears of various species are supposed by the uninformed to be extremely numerous and very dangerous throughout the interior of Alaska. Both suppositions are without any foundation in fact. There is no species of bear that is really numerous in that country, the black and the cinnamon are more common than any other, and only rarely is one of them met with, and then only in remote places.

The black bear ranges throughout the whole interior of Alaska, from the sources of the Yukon and Tanana to Holy Cross, below which it is not often seen.

The ferocity of these bears is largely a matter of imagination. A black bear will almost invariably "hike for the tall timber" when discovered, unless it be a female with cubs. A mother animal of almost any species will make some defense of her young, and in so doing acts strictly on the defensive. In this respect the black bear is not peculiar.

Perhaps the worst charge that can be made against the black bear is that it is quite disposed and ready to appropriate to its own use the provisions it chances to find in the prospector's or trapper's cache. If the brute would stop when he has eaten all he can, it would not be so bad; but he destroys everything he can not eat, which is a very reprehensible practice, of no apparent benefit to the bear and very hard on the owner of the cache. For this reason it is easy to have sympathy for the prospector and hard to feel any for the bear.

The summer and fall food of the black bear is salmon wherever they can be obtained. In the fall blueberries constitute the principal food. Bears, however, are omnivorous at times and will eat almost anything they find. They are said to be destructive to young caribou and moose.

The time when they go into retirement and begin their hibernation depends somewhat on the food supply; so long as food is easily obtainable they are apt to remain active. If a cache of caribou meat or other provisions is found late in the fall the bear will remain with it until all is eaten.

As is well known to naturalists and other careful observers, it is a common thing to find both cinnamon and black cubs in the same litter. As bears of cinnamon-color phase are in Alaska usually, if not always, called brown bears, and as the Alaska game law protects the brown bear, a great deal of confusion has resulted. The situation is briefly this: The brown bear of the Alaska game law means the big brown bear of Kodiak Island and the several closely related species of big brown bears on the adjacent mainland. These, and only these, are covered by the game law. A cinnamon or brown-colored individual of the black-bear species does not come under the Alaska game law, but under the Alaska fur law.

MUSKRAT (TENA INDIAN NAME, "BEKENALA").

Muskrats are quite common in all suitable situations throughout Alaska. In the interior the districts suitable for muskrats are usually limited in area, while along the lower rivers, near the coast, and in the tundra belt, suitable territory is found nearly everywhere. They are particularly abundant on the lower Yukon and Kuskokwim.

The ice in many parts of Alaska does not go out until May or even later, and the muskrats can not be taken until then. In recognition of this condition and the further fact that the muskrat fur remains prime in most parts of Alaska until June, the open season for muskrats has been extended to June 1.

Muskrats are not often trapped or hunted by white men, who regard them as too insignificant to merit their attention. They are therefore hunted chiefly by the Indians, who usually secure them by shooting rather than by trapping. The Indians watch for the muskrats as they swim about in the sloughs and ponds and shoot them with 22-caliber rifles.

As other kinds of fur become scarcer and the value of muskrat pelts increases, this animal will be hunted more assiduously, and white men will engage in the business.

Although muskrats are chiefly nocturnal or crepuscular in their habits they are often seen swimming about and feeding in the daytime, and it is then they are usually hunted.

One rarely sees a muskrat house in the interior of Alaska; they apparently live mostly in holes in the bank.

FOXES.

Red foxes were formerly quite plentiful on the hills and ranges surrounding the Tanana Valley, and fairly abundant over most of the interior of Alaska. They were until recently quite abundant on the Healy River, but one is seldom seen in that region now, a condition due, it is claimed, to the use of poison about 10 years ago.

The headwaters of the Nenana River are now the best fox grounds in the Tanana Valley. Poison was used in that region several years ago, but the reprehensible practice was discontinued with the result that foxes are increasing in that region. Recently several valuable skins of black and cross foxes have been obtained there. Wherever red foxes occur, black, silver, and cross foxes (all color phases of the red fox) are occasionally found. Some very fine ones have been secured along the Alaska range in the upper Nenana and Mount McKinley region.

White foxes are found in considerable numbers along the Bering Sea and Arctic coasts. Large numbers are obtained in the northern parts of Seward Peninsula, and still larger quantities come into Alaska from Siberia.

Trapping for white foxes is carried on almost exclusively by the natives. They use no. 2½ traps. North of Point Hope they do not do any trapping until December, and as the weather is likely to be stormy in the middle of the winter, most of their trapping is done in March. The natives and traders claim, and it is believed justly, that, on account of the high northern latitude, the fur is in the best condition in March and that it is prime even into April. In recognition of these conditions the open season for foxes in the region tributary to the Arctic has been extended to April 1.

WOLVERINE (TENA INDIAN NAME, "NEETSIL").

The wolverine is found sparingly throughout the interior of Alaska, but occurs all along the Alaska range. Although it prefers a high, wild, rocky country, it is sometimes found in more open regions.

While the wolverine will rarely catch or kill any live animal (except perhaps young moose and caribou) it will feed readily and ravenously on any animal it finds dead. It will rob the natives' caches of their supply of meat and fish, cunningly steal the bait from the hunters' traps and any animal that it finds caught in the trap. It will steal anything, whether of food value or not. In order to do successful trapping in any region the trapper must first rid the district of wolverines. If this is not done the trapper will find not only the bait stolen from his traps but the animals caught will also be stolen if there happens to be a wolverine in the neighborhood.

The wolverine is such a greedy animal that its capture is usually not difficult. Sometimes, however, it shows much cunning, often eluding the trapper for an entire winter. Because of the great harm it does in destroying the trapper's catch, the general feeling in Alaska is that the wolverine should not he protected.

A large trap must be used for wolverines, owing to their heavy, broad feet.

The pelt possesses considerable value, the price now being $8 to $10.

Recently a good many wolverine pelts have been brought into the lower Yukon and Nome from Siberia. Some are sent to Seattle and San Francisco and later resold to Alaska traders. Those brought to Nome are usually distributed to small traders who dispose of them for local use.

LAND OTTER (TENA INDIAN NAME, "MELAZONA" OR "MEZIHA").

The land otter, like the beaver, has been, and perhaps still is, in danger of commercial extinction in Alaska. There are, however, several places in which it is still found in considerable numbers. It is common in the tundra about the lower Yukon and Kuskokwim and is found in some numbers at the headwaters of the Tozitna,

Melozitna, Nowitna, and Kuskokwim. In many places it is so rare and so hard to trap that no effort is made to capture it.

During the year ending November 15, 1912, land-otter shipments were made from 61 different points in Alaska. The largest number, 255, was from Juneau, and the total was 1,480 skins, valued at $20,720.

In the interior of Alaska the otter feeds largely upon whitefish, lake herring, and grayling. As these fishes are abundant in most streams, the otter should find plenty of food.

BEAVER (TENA INDIAN NAME, "NOYA" OR "TSO").

There are very few beaver left on the Tanana or its tributaries. Old beaver dams and beaver-cut trees are often seen, but rarely or never a beaver. At the headwaters of the smaller streams one occasionally finds a small family of beaver. On the Kuskokwim and lower Yukon they are not so rare. From Melozitna down to the tundra a good many have been reported in the small streams and ponds back of the hills. One large colony and several small ones are reported on the Tacotna. They are probably more common on the Kuskokwim.

The first regulations promulgated for the protection of fur animals in Alaska provided a close season for beaver until 1915. The information obtained by the fur wardens during their first year shows that this will not be adequate, and the close period has therefore been extended to November 1, 1918. The very considerable increase in numbers observed since the close season was established justifies the belief that beaver will be so abundant by 1918 or perhaps 1920 as to justify a limited amount of killing.

So far as could be learned the regulation against killing beaver is observed. Now and then an Indian may kill one. Indians are very fond of beaver meat and can not always resist the temptation to kill when opportunity offers.

LYNX (TENA INDIAN NAME, "KAZENA" OR "NODUIHA").

The lynx is found throughout the heavily wooded interior of Alaska, especially wherever rabbits are found. When rabbits are abundant lynx are quite common; whenever rabbits are scarce, as is likely to be the case periodically, lynx are rarely seen. Thus they may be common one year in a certain locality and totally absent the next.

The lower Nenana is at present one of the best lynx countries.

While lynx feed chiefly on rabbits they will eat other small mammals such as squirrels, mice, shrews, and the like; they also destroy a good many birds, especially the ground nesting species.

The lynx is a stupid animal and easily caught. A common set is as follows: Several rabbits are hung on a small stripped spruce tree, and rabbit skin or old moose hide thrown on the ground under the

tree. Large no. 3 traps are used, 3 or 4 being placed indifferently around the base of the tree. In trying to reach the bunch of rabbits the lynx is sure to step in one of the traps. When caught the lynx does not make violent efforts to escape as do most fur-bearing animals, but lies quietly down until approached, when it will, instead of trying to escape, spring savagely at the visitor. Another favorite method of capturing the lynx is by snaring. Extra strong picture wire is used and the snare is adjusted at the base of a small tree where bait has been placed over a rabbit trail.

The total number of lynx skins shipped from Alaska in 1911–12 was 2,720. The principal shipping points were Tanana, St. Michael, Nome, Fort Yukon, Bettles, and Fairbanks.

WOLF (TENA INDIAN NAME, "YES" OR "TIKONA").

Wolves are not common in the Yukon-Tanana valley, though they are sometimes seen southward toward the Alaska range and westward toward the Bering coast. In southeast Alaska they are said to be abundant and very destructive to deer, and, while reports regarding their ravages and the menace to human life have doubtless been greatly exaggerated, the department has recognized this situation as justifying the withdrawal of protection to wolves, and on April 2, 1912, a bill (H. R. 22775, 62d Cong., 2d sess.) providing a bounty upon them was introduced in the house by Mr. Sulzer.

No action was taken on this bill, but it is hoped that legislation of this character may be secured at an early date.

The total number of wolfskins shipped from Alaska in 1911–12 was only 103. The majority of these came from Nome, Ketchikan, and Wrangell. Doubtless many of those shipped from Nome had been brought over from Siberia.

On the lower Yukon wolfskins are in demand by the natives, from which to make trimmings for parkas and for robes.

RED SQUIRREL.

Red squirrels are very abundant in practically all the forested parts of Alaska. They were observed to be exceedingly abundant in the spruce forests along the Fairbanks trail. They are also very numerous in all the forests about Cook Inlet and Prince William Sound. In the vast burnt-over areas in central or interior Alaska few or none may be seen, but as soon as trees occur there the squirrels are to be found. They are very tame and will eat their spruce cones within a few feet of the hunter, keeping up a constant chattering or scolding the while.

The quantity of spruce cones they will consume is surprising. At the base of a tree in which a red squirrel has its nest there may frequently be seen a pile of husked cones a foot or two high and 5 or

6 feet in diameter. In these huge piles the squirrels sometimes place bunches of green cones for future use.

Their nests are usually built of moss and sometimes lined with feathers. The nest is globular and placed on a branch 10 to 20 feet above the ground. Several nests often occur in one tree. Whether the squirrels kill and eat small birds may be questioned, though bones and feathers of birds are often found in their kitchenmiddens.

Although the skin of the red squirrel is of little commercial value at present, the fur is of good quality and, with the decreasing abundance of other furs, will doubtless soon be in greater demand. The total number shipped from Alaska last year was 611, which number doubtless included spermophiles or ground squirrels, as well as red squirrels.

CARIBOU.

Caribou occur in considerable numbers in the rutting season on the divides and in the valleys between Fairbanks and Circle, but none within 70 or 80 miles of Fairbanks. The principal caribou country is in the region of the Chena hot springs, Wood River, Kantishna, and Bonnifield country. They are found, however, on nearly all the slopes and tundra plateaus of interior Alaska. They are not found in the Bering coast tundra nor on the Yukon below Koyukuk.

The high plateaus over which the caribou range in winter are of wide extent. In walking over these plateaus one can see where the caribou have pawed up the snow to get at the moss beneath, but the animals themselves are not easily seen. Large numbers of caribou are killed by the big game hunters and pot hunters. Usually the killing is done after cold weather begins, when the carcasses can be frozen and cached until marketed. Often, however, large numbers are killed too early, the expected freezing weather does not come in time, and the carcasses spoil before they can be marketed.

The skins of the caribou make excellent sleeping bags and a few are shipped or utilized locally every year for that purpose.

TRAPPERS AND HUNTERS AND THEIR METHODS.

Hunting and trapping fur-bearing animals is carried on by both white men and Indians. The white men engaging in this business are of two classes, first, those who devote all or most of their time to trapping during the open season, and, second, those who are primarily prospectors and trap only incidentally. The trapper must be able to endure the rigors and hardships of the long winter, but he must also be able to stand the life of isolation. Often he lives alone and it may be 50 to 100 miles to the nearest neighbor. Usually, however, two men trap together.

While some trappers do not start for the trapping region until after snowfall, when they can travel with dog team, many others start out

earlier, take with them in a boat an outfit and supplies for a year, and, poling up or down a stream, reach the region selected in time to establish a comfortable camp and thoroughly reconnoiter the territory before the actual trapping season begins. If they are prospectors, they will at the same time amuse themselves in that fascinating vocation. It will sometimes take them a month or two to reach their destination, and by the time they have built or put their cabins in shape and laid out their trap lines winter will have arrived.

The man who combines trapping and prospecting does not usually succeed very well at either, the best he can hope to do being to catch enough furs to grubstake him for his prospecting operations during the next summer.

The white trapper is usually much more successful than the Indian. The Indian will regard 6 to 10 mink or marten a big catch; a white man would get many more in the same region. An Indian will trap in the same region year after year, while the white trapper will practically exhaust it in one season.

The Indian will rarely set his traps more than two or three miles from his camp, while the white man will extend his line to 25 to 60 miles. He will require 2 to 4 days to run the line and he must have a cabin at each end, often with temporary shacks between. Many trappers, especially those trapping lynxes, have small dog-teams with which to make the rounds.

The life of the trapper, while fascinating in many respects, is one beset with many hardships and privations, and the financial return is usually small. The average trapper does not receive more than $350 for his season's catch. A few make as much as $700 to $900.

On the lower Yukon and along the Bering Sea coast the trapping is done mostly by Eskimos. There are a few squaw men who trap white foxes, the actual work being done chiefly by their women. The Eskimos are more thrifty, cleaner and better trappers than the Indians; some of them are relatively well off. The Indian would rather hunt muskrats than go after those furs requiring greater effort. Very few Indians are successful trappers and very few ever learn to stretch a skin properly or to take proper care of it.

OBSERVANCE OF THE FUR LAW AND REGULATIONS.

In general, the law and the regulations meet with approval, though there is some objection to those relating to bears and muskrats. Practically all traders believe in the protection of fur-bearing animals. There are in each region usually a few trappers who will not observe the regulations unless compelled to do so, but they are among the lowest class of irresponsible trappers who have little or no regard for any law. The worst class and the hardest to deal with are those who use poison, but it is believed this class is decreasing.

Popular feeling has been educated to the extent that a trapper who uses poison incurs the enmity of his fellows. If a trapper is seen going into the woods with a light pack this indicates that he has no traps and he at once becomes an object of suspicion to all other trappers and prospectors until he proves his innocence. In the winter of 1910–11 one trapper on the Newana River was reported to the district attorney's office for using poison, and a half-breed in the same region was suspected of doing so. The trapper left the country and the half-breed is believed to be obeying the regulations now.

The fur buyers who frequent the lower Yukon and the Kuskokwim have been too much disposed to purchase all skins offered them, whether prime or unprime, but they are now beginning to realize that this is poor business. The promulgation of a regulation against the shipment of unprime skins will no doubt greatly improve conditions in this respect.

White trappers as a rule will not catch an animal with an unprime skin if they can help it. The Indians are less particular. As they use as food the flesh of many of the species of fur animals they will be disposed to pay very little attention to close seasons or the condition of the fur but will kill the animals at any time when they may desire them for food. However, if the trader will refuse to purchase unprime skins the Indians will doubtless do less trapping out of season.

Dealers on the Arctic coast claim that under the regulation regarding white foxes none can be caught in that region. From November to March there are continual snow storms and heavy winds which render trapping impossible. They claim that very little trapping can be done until toward the last of February and that the fur remains thoroughly prime until in May.

THE MUSSELS OF THE CUMBERLAND RIVER AND ITS TRIBUTARIES

By Charles B. Wilson and H. Walton Clark

Bureau of Fisheries Document No. 781

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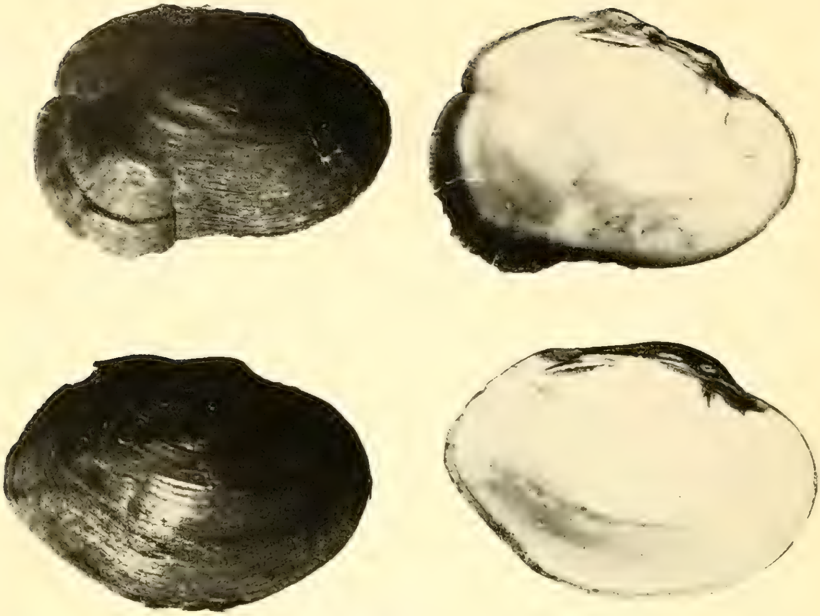

FIG. 1.—TRUNCILLA WALKERI, NEW SPECIES.

Upper figures, females; lower figures, males.

FIG. 2.—THE GREAT FALLS OF THE CUMBERLAND, 85 FEET HIGH, A BARRIER TO THE ASCENT OF FISH AND MUSSELS.

THE MUSSELS OF THE CUMBERLAND RIVER AND ITS TRIBUTARIES.

By Charles B. Wilson and H. Walton Clark.

INTRODUCTORY.

The purpose of this investigation was to ascertain the distribution, relative abundance, and habits of the various mussel species living in the river and its tributaries, and to make an intelligent appraisal of the mussel resources of the river from a commercial standpoint.

The party was under the supervision of Dr. Robert E. Coker, director of the United States Biological Station at Fairport, Iowa, who furnished general instructions to be used by all field parties engaged in mussel investigations. In addition to the authors, the party included the late Mr. J. F. Boepple, the shell expert of the Fairport station, and Mr. Ernest Danglade, now scientific assistant in the Bureau of Fisheries, each of whom contributed fully as much as either of the authors to the success of the investigations.

The work was begun about May 10 near the mouth of the Cumberland River, and conducted thence upstream through the State of Kentucky and into Tennessee as far as Clarksville. During the previous year it had been carried from Pineville, Ky., to Celina, Tenn. Accordingly, it was now resumed at Celina, where the Obey River, a tributary of the Cumberland from the south, was investigated. Thence the work continued slowly down the Cumberland itself.

From Jellico, Tenn., and Williamsburg, Savoy, Corbin, Livingston, and Barbourville, Ky., as centers, the upper portions of the Cumberland River, the Clear Fork, Big South Fork, Laurel and Rock Castle Rivers were examined. Neither the main river nor any of these tributaries is navigable for a boat, so that the investigations had to be conducted by team, driving along the banks or visiting convenient fords and shallows.

The party then drove by team from Williamsburg to the Cumberland Falls, proceeded again by team from the falls to Parkers Lake station, and thence by rail to Burnside, Ky. This is the head of steamboat navigation on the river, and here a small boat was constructed in which to proceed down the main river, thus completing the survey of the entire river.

During all these investigations the methods followed by the two divisions of the party were made as different as possible in order to cover the field more thoroughly. Mr. Boepple used the crowfoot dredge, tongs, and mussel rake, and worked the deeper portions of the river. The rest of the party covered the shallower water, riffles, sand bars, and smaller tributaries, and, of course, obtained the mussels by wading.

A careful record was kept of the temperature of the water at the various stations, and as often as seemed advisable samples were taken for subsequent analysis.

In addition to making original observations the party secured as much information as could be obtained from local fishermen and clammers with reference to the location of the mussel beds, past and present operations upon them, and the finding of pearls and baroques.

For such information we are particularly indebted to the following persons: Mr. Walter, of Dover, Tenn., an extensive dealer in shells; Mr. Samuel Dabbs, a clammer of Dover; Mr. M. K. Clark, proprietor of the blank factory at Clarksville, Tenn.; and Mr. Cicero Harris, a boatman who had floated down from the upper part of the river fishing and clamming, and who knew the river more intimately than anyone else it was our fortune to meet. To these gentlemen as well as to many others who extended favors and assistance whenever opportunity offered, our sincere thanks are tendered.

As fast as they were obtained, the samples of water and specimens were shipped to the biological station at Fairport. The shells were subsequently identified and studied by the principal author with the results herein set forth.

THE CUMBERLAND RIVER.

GENERAL DESCRIPTION.

The main branch of the Cumberland River rises among the foothills of the Pine Mountains, in the southeastern corner of Kentucky. It flows southwest along the eastern side of the mountains, receiving many tributaries. Near Pineville it turns at a right angle and flows northwest through a wide gap in the mountains, and then swings to the south, its general course being that of a half circle, convex toward the north. At State Line, in Monroe County, it crosses into Tennessee, its general course in the latter State being also that of a half circle but convex toward the south.

At Tobaccoport, in Stewart County, it crosses the State line back into Kentucky, flows northwest and enters the Ohio at Smithland, only 12 miles above the mouth of the Tennessee River at Paducah. The distance from the source to the mouth in a straight line is about 325 miles, but the river is so extremely crooked that its total length

is nearly 750 miles. Its principal tributaries are the Laurel and Rockcastle Rivers from the north, which join it within a few miles of each other at the southwestern corner of Laurel County, Ky.; the Big South Fork, whose mouth is at Burnside, Ky.; the Obey River from the south at Celina, Tenn.; Roaring River, from the south, at Gainesboro Landing, Tenn.; Caney Fork, from the south, at Carthage, Tenn.; Stones River, from the south, 15 miles above Nashville, Tenn.; Harpeth River, from the south, at Pardue, Tenn.; and the Red River, from the north, at Clarksville, Tenn.

The Cumberland is navigable during high water from its mouth to Burnside, Ky., a distance of 525 miles, and a system of locks is in process of construction which will make navigation possible during the entire year.

PHYSIOGRAPHY.

The area drained by the river and its tributaries is about 25,000 square miles, and embraces mountain ranges, a continental plateau (the Cumberland Plateau), and lowlands. Along the upper reaches of the river among the Cumberland and Pine Mountains in the eastern portion of the plateau the rocks are largely Cambrian sandstone; through the remainder of the plateau and the long stretch of lowlands they are almost universally limestone. The dividing line is at Cumberland Falls in the western part of Whitley County, Ky., where the river plunges over a wall 85 feet in height. From the source to the falls the river has nowhere cut its channel very deep; below the falls, and especially through the plateau, the banks are lined almost continuously with high limestone cliffs, filled with caves and roughly weathered. The faces of these cliffs furnish abundant evidence of past upheavals in numerous faults and contortions of the strata, as well as in repeated anticlinal and synclinal folds, differing considerably in intensity at different localities.

Above the falls the river valley is comparatively narrow, but below the falls it widens somewhat, and the river winds back and forth in broad and then in shorter curves, with cliffs now on one side and now on the other.

So evenly has the channel been worn down through the soft limestone that there are no rapids of any importance below the falls, and steamboats can run from the mouth up to Burnside in Pulaski County, Ky., within comparatively few miles of the falls, as already stated. This makes the river easy to navigate for two-thirds of its entire length, and since it runs through a great region remarkable for its mineral and agricultural resources and its large forests, but with a physical contour which makes the building of railroads exceedingly expensive, the Cumberland is destined to be one of the most important commercial highways of the United States.

COMPARISON WITH MAUMEE AND KANKAKEE RIVERS.

Both the Maumee and Kankakee Rivers, which were examined by the present authors, are situated in regions profoundly modified by the great glacier. In their basins the ice mass first removed the entire fauna and flora, and when it melted established new channels by which the river was restocked.

The Cumberland Valley presents an entirely different history. It is situated in a region which is geologically very old and which has not been much disturbed since its first upheaval, except by the ordinary forces of weathering and erosion and the subsequent formation of mountains. The Cumberland and Pine Mountains, as well as the great Cumberland Plateau, are portions of the Appalachian system, and the wrinkling which formed them took place toward the close of the Upper Silurian period. Originally very much higher than at the present day, they have gradually yielded to weathering and erosion, but are otherwise unchanged. The great glacier reached only a little below the Ohio River, which is far to the north of the Cumberland Valley.

CHARACTERISTICS OF THE MUSSEL FAUNA.

Consequently a primitive fauna and flora are to be looked for in this valley, one that began with the very origin of the valley itself, and has been gradually developing ever since without any serious disturbance; and in fact the best American authorities regard the Mississippi Valley as the original home of fresh-water mussels upon this continent, the rest of the rivers, ponds, and streams having been populated from this source. Some authorities even say that there is evidence to show that this fauna developed first in the New World and then spread to the Old World. However that may be, it is certain that the Mississippi area has the greatest diversity of species and the most magnificent shells to be found anywhere in the world.

The Cumberland and Tennessee Valleys are among the very oldest portions of the Mississippi region, and are commonly looked upon as the center of this wonderful mussel fauna. Accordingly we should expect to find in them a great diversity of species, some of which would be found nowhere else, and that such is the case has been well shown by many conchologists. Over 80 different forms of mussels have been reported from the Cumberland River, and the present examination has added 3 others. This is considerably more than twice the number found in the Maumee or the Kankakee River systems, and is a remarkably large representation compared with any river of equal size. A few of these species have never been reported from any other locality, but the great majority are common to the southern portion of the Mississippi system. Such of these as were found during the present examination are enumerated on pages 14 to 19.

GEOGRAPHIC DISTRIBUTION OF THE MUSSELS.

CONTRAST BETWEEN THE RIVER ABOVE AND BELOW THE FALLS.

The Cumberland Falls establish a natural barrier, dividing the river into an upper one-third and a lower two-thirds, between which there can be practically no interchange of animal life, and very radical differences appear in the mussel fauna. Above the falls only a very few species of mussels are found, and these are considerably dwarfed. *Unio gibbosus* is the only species in any abundance, and rarely one may find examples of *Lampsilis ovata*, *Alasmidonta minor*, and *Anodontoides ferussaciana*. This scarcity of species is as much due to the fact that all the conditions are unfavorable (see p. 23) as it is to the lack of intercourse past the falls, and in all probability there would be very little profit in stocking the river above the falls with mussels. Indeed we were told that some *Lampsilis ovata* were taken from below the falls and transplanted to the river above about seven years ago, with visible results, possibly, in the few dwarfed specimens of this mussel now present in the upper river.

In the river below the falls conditions are totally different. In the very pool at the base of the falls were obtained 19 species of mussels, all of them of normal size and perfectly healthy. And from this point down to the Ohio every portion of the river bed that is at all suitable for mussels is fairly covered with them.

Much of this part of the river has been thoroughly worked over by agents of the button factories, and the location, extent, and possibilities of the various beds are well known. Some clammers even have a memorandum list of the beds, giving the percentages of usable and useless shells in each. Many of these beds have been worked for some time, a few of them as long as 10 years, and an immense number of shells have been taken, as many as 200 to 300 tons from some of them. But in spite of the great number of mussels taken out, the river as a whole, according to general accounts, does not show any marked depletion except in one or two restricted localities. On the contrary, a comparison of many beds in the vicinity of Celina, Tenn., examined by Mr. Boepple in 1910 and again in 1911, showed a considerable increase. This was especially true of beds situated above the silt in the back water from the various lock dams. Such places seem peculiarly suited to rapid mussel growth, and furnish thereby a valuable suggestion as to the best localities for artificial propagation.

Of course the mussels that were too close to the dams, or that were in the mouth of tributaries filled with back water from the dams, would be killed by the increased deposit of silt, and the rise of water from behind the dams makes it harder to secure the mussels.

On the whole, however, the benefits seem greater than the disadvantages.

Incidentally it is worthy of note that the water privileges at Cumberland Falls have been leased to a company which has already begun operations toward establishing a power plant for furnishing electricity to Louisville and other cities.

FAUNISTIC DIVISIONS OF THE RIVER BELOW THE FALLS.

For our present purpose we may divide the river below the falls into four sections, fairly well separated by natural conditions, and by differences in the relative numbers of the various mussels. These sections will be discussed in order, beginning at the falls and proceeding toward the mouth of the river.

First section, from Cumberland Falls to Celina, Tenn., 175 miles.—While there are numerous and rich mussel beds along this portion of the river, there is no commercial clamming. This is chiefly due to the high percentage of culls, small species, and pinks, the latter mostly elephant-ear (*Unio crassidens*). The most important commercial mussel is the southern mucket (*Lampsilis ligamentina gibba*).

The elephant-ear is not killed in any great numbers by pearlers because it is not looked upon as a pearl-bearing species, while other mussels, supposed to contain pearls, are often nearly exterminated. Up to the present time, moreover, this mussel has been refused by the buyers for button factories. Consequently it has been neglected or culled out by the fishermen in the lower sections of the river and left comparatively free to breed, the glochidia to be picked up by fish and carried up toward the falls. Natural conditions have in some way also given the purple spike (*Unio gibbosus*) an advantage over other species above the falls. Similar conditions may have been equally favorable to the closely related elephant-ear below the falls. Perhaps these considerations will help to explain their preponderance in these two localities.

There are 19 mussel beds in this section of the river and the proportion of commercial shells and culls, together with the size of the bed and the kind of bottom, are shown in the following table:

FIRST SECTION, CUMBERLAND FALLS TO CELINA, TENN.

Mussel beds.	Percentage of commercial shells.						Percentage of culls.			Conditions.			
	Muckets.	Pigtoes.	Niggerheads.	Sand-shells.	Pocketbooks.	Warty-backs.	Spikes.	Elephant-ears.	Small or thin shells.	Size of bed.	Kind of bottom.	Temperature of air.	Temperature of water.
												° F.	° F.
Just below falls	24	....	....	1	6	10	15	7	25	Large	Rocks	81	84
Big South Fork opposite Parkers Lake	5	....	....	4	3	10	26	15	37	...do	...do	92	86
Big South Fork above Burnside	7	....	....	3	....	10	29	5	40	Medium	Gravel	86	82
Railroad bridge, Burnside	30	....	....	....	....	2	16	28	20	Small	...do	....	....
Fishing Creek Bar	35	....	....	5	....	....	16	28	10	...do	...do	86	85
Fords Island	....	....	....	....	....	....	20	60	20	Large	Sand	86	85
Mill Springs Bar	5	2	....	1	9	32	1	14	40	Medium	Gravel	86	82
Robertsport, Ky	22	....	....	....	9	15	2	20	25	Large	...do	....	....
One mile below Lock 21	10	....	....	2	....	....	20	50	10	...do	Mud	86	85
Horseshoe Bottom	12	....	....	3	....	....	20	45	10	...do	Sand	....	....
Beaver Creek	4	....	....	....	5	10	6	....	70	...do	...do	80	81
Indian Creek Shoals	40	1	....	2	5	2	6	40	4	...do	Gravel	87	81
Snow Island	5	9	14	1	....	5	1	30	20	Small	...do	....	....
Wells Island	40	1	....	....	1	....	....	50	8	Medium	...do	....	....
Selfs Shoals	40	....	....	....	3	....	....	50	6	Large	...do	....	....
Greens Bar	20	2	2	2	6	8	2	40	8	Medium	Sand	....	....
Champs Shoals	35	1	1	....	....	....	1	60	....	...do	Gravel	....	....
Biggerstaff Bar	10	10	....	....	....	33	2	18	15	Large	...do	80	82
Celina, Tenn	10	10	2	....	6	6	4	20	30	...do	...do	....	....

The table shows at a glance that the proportion of culls is so large in nearly every one of the beds that they yield but a poor profit to the clammer.

The conditions, however, are everywhere favorable to mussel growth, as is evidenced by the number and variety of the shells. These mussel beds each contain a fair proportion of commercial shells, three of which, the southern mucket, the butterfly, and the Ohio River pigtoe, might well be propagated artificially. In this way the preponderance of culls could be greatly reduced in a few years, if not wholly overcome.

Although there is no clamming, there is considerable pearling in this section of the river and large piles of shells were found in a number of places where the pearlers had left them. This was especially true at Fords Island, Mill Springs Bar, below Lock 21, Wells Island, Selfs Shoals, and Champs Shoals. It will be noticed that in coming down the river the first pigtoes were found at Mill Springs Bar and the second lot at Indian Creek Shoals.

Second section, from Celina to Nashville, Tenn., 190 miles.—The mussel beds increase a little in number and considerably in size along this section of the river, and in consequence there is more commercial shelling. The percentage of pinks and spikes steadily decreases, especially that of the former, and there is a corresponding increase in the commercial species. The Ohio River pigtoe becomes the most common button shell, while the elephant-ear not only decreases in numbers, but partially changes its color, and with

white nacre it answers fairly well for button making. The conditions are even better suited for mussel propagation than in the preceding section.

The following table gives the percentages of the various mussel species and other useful data:

SECOND SECTION, CELINA TO NASHVILLE, TENN.

Mussel beds.	Percentage of commercial shells.						Percentage of culls.			Conditions.			
	Muckets.	Pigtoes.	Niggerheads.	Sand-shells.	Pocketbooks.	Warty-backs.	Spikes.	Pinks.	Small or thin shells.	Size of bed.	Kind of bottom.	Temperature of air.	Temperature of water.
												°F.	°F.
Larrys Shoals	25	30	15	....	5	5	2	17	....	Small	Gravel	....	....
Roses Bar	20	25	10	....	10	10	5	20	....	...do	...do	....	....
Gainesboro Landing	5	....	....	....	....	....	....	....	85	...do	...do	....	....
Simpsons Island	20	30	10	1	....	5	10	20	5	Large	Sand and mud.	....	....
Saltlick Island	6	20	15	....	3	20	....	17	10	Medium	Gravel	80	79
Phillips Branch	20	15	15	1	5	10	6	20	....	...do	...do	....	....
Goodalls Island	20	15	15	2	6	15	2	20	4	Large	...do	80	83
Johnsons Eddy	20	25	10	1	5	12	....	25	....	Small	...do	....	....
Beasleys Bar	10	5	5	....	....	5	....	70	....	Large	...do	....	....
Cotton Bar	10	40	10	2	10	4	6	20	....	...do	...do	....	....
Puryears Bar	3	37	10	2	....	18	2	4	10	...do	...do	....	82
Cairo Island	20	35	10	....	2	15	2	15	....	...do	...do	82	85
Coles Ferry	30	25	10	....	....	10	1	6	10	...do	...do	....	....
Lindsleys Island	20	15	10	1	8	12	5	12	10	...do	...do	91	85
Hills Island	20	40	10	2	5	10	5	5	....	...do	...do	84	85

In addition to the beds above enumerated, small and not very profitable ones were reported by local clammers at Bullards Gap, 8 miles below Simpsons Island; at Wartrace Creek Bar, 4 miles further down the river; at Pinks Bar, 2 miles below; at Lower Holliman Island, a mile below Phillips Branch; at the head of Sullivans Island, 5 miles lower; at the foot of the sand shoals near Haneys Landing; at Turkey Creek Shoals, just above Carthage; at Hunters Point, a mile below Lock No. 5; at the mouth of Spring Creek, 5 miles above Cairo; at the foot of Cunningham Island, 2 miles nearer Cairo; at Mauskers Island, just above Edgefield Junction; and at Priestly Shoals, 5 miles above Nashville.

At Gainesboro Landing the mussels were all obtained from Roaring River, a tributary of the Cumberland from the south (see p. 29).

At Cotton Bar 12 tons of shells were cribbed along the bank, of which 60 per cent were pigtoes; washboards, monkey-faces, and butterflies were also common. Simpsons Island was the highest point on the river where clammers were found actually at work.

Muskrats were making heavy inroads into the mussel beds at several places, notably at Puryears Bar, at Mauskers Island, and Hills Island. All the piles of shells left by these animals showed that they have a decided preference for pigtoes.

Third section, from Nashville to Dover, Tenn., 105 miles.—This portion of the river has been more thoroughly worked by the clammers than has any other. It contains the largest and most valuable mussel beds of the entire river, and the location of all the beds, together with their size and relative value, are well known. The proportion of merchantable shells, moreover, has increased until there is no longer any locality in this part of the river where the pinks and spikes preponderate. The Ohio River pigtoe still continues to be the most common and valuable commercial shell, but the niggerhead becomes a close second and from Clarksville to Dover outranks the pigtoe.

So much does the commercial clamming increase and so great is the influence of the ready local market for shells that pearling as a distinctive vocation practically disappears. Every clammer is on the watch for such pearls as may be found in the shells which he cleans for the market, but there is very little hunting for pearls with no other object in view. This increase in the commercial clamming is due almost entirely to the activity of the button-blank factory at Clarksville, near the center of this third portion of the river, which furnishes a convenient market for all the shells taken in the vicinity.

The proprietor of this factory, Mr. M. K. Clark, is much interested in everything that pertains to clamming, and with his assistance several thousand glochidia of the yellow sand-shell were taken from ripe female mussels and placed in tubs of water with small fish caught in adjacent ponds. After the young mussels had fastened themselves to the fish the latter were turned loose in the river. This was the first time that mussels had ever been artificially planted in the Cumberland. Mr. Clark also gave us most of the data for the following table of mussels beds:

THIRD SECTION, NASHVILLE TO DOVER, TENN.

Mussel beds.	Percentage of commercial shells.						Percentage of culls.			Conditions.			
	Muckets.	Pigtoes.	Niggerheads.	Sand-shells.	Pocketbooks.	Warty-backs.	Spikes.	Pinks.	Small or thin shells.	Size of bed.	Kind of bottom.	Temperature of air.	Temperature of water.
												°F.	°F.
Penitentiary Bar	....	20	10	15	....	10	5	15	15	Large	Gravel	80	82
Robertsons Island	....	40	10	5	....	10	5	15	10	...do	...do	....	....
Gowers Island	2	50	5	5	2	5	....	25	5	Very large.	...do	....	....
Harpeth Island	5	45	5	5	2	10	5	15	5	...do	Mud	....	....
Half Pone Bar	5	10	15	....	5	20	1	2	30	...do	Gravel	81	78
Burtons Creek	5	10	10	5	2	15	5	10	15	Medium	Rocks	....	....
Cotton Gin Bar	5	15	10	5	5	10	5	30	10	...do	...do	....	....
Seven Mile Ferry	3	24	20	7	5	15	14	5	5	Large	Mud	....	....
Guisers Bar	3	55	10	5	1	15	1	8	....	...do	Gravel	....	....
Clarksville	5	30	20	10	5	10	5	10	....	...do	...do	....	....
Trices Landing	....	53	28	....	....	8	4	7	....	...do	...do	86	82
Meeks Spring	....	74	7	10	....	8	....	1	....	...do	...do	....	....
Martins Shoals	....	38	15	8	....	15	....	2	10	...do	...do	....	....
Hematite Bed	5	20	35	5	....	15	3	5	....	Small	...do	....	....
Carbondale Bed	....	25	20	8	5	20	2	1	10	Large	...do	....	....
Yellow Creek Towhead	5	30	20	10	5	15	....	5	5	...do	...do	....	....
Sailors Rest	....	30	25	10	....	15	....	4	7	...do	...do	....	...
Wild Cat Creek	....	25	20	6	....	12	....	5	10	...do	...do	....	....

There are also small beds containing a limited number of marketable species at the following localities: Just below Lock No. 1, along the north bank of the river, badly depopulated by sand dredges; near the Tennessee Central Railroad bridge, also along the north bank; at Whites Creek Bar, considerably dug up by sand dredging; along the mouth of Indian Creek, 20 miles below Nashville; below Lock A on the south bank of the river; at Betsytown on a very rough and rocky bottom; at Davis Riffle extending diagonally across the river; opposite the pumping station of the Clarksville waterworks; at Kentucky Landing and Red Rock Landing, the latter bed nearly worked out; at Palmyra Island along the west bank of the river; at Cumberland City just below the steamboat landing; and at Wells Island, 2 miles farther down the river.

Thus the third section of the river contains a larger number of mussel beds than any of the other sections, and the beds are richer both in numbers and species of mussels. It is the section of the pigtoe and niggerhead mussels, and those species are the most abundant button shells. There has also been a marked increase in the yellow sand-shell and the monkey-face.

This portion of the river, however, is also the nearest to the center of demand, and consequently its beds have been worked longer and harder than any of the others. The most of them do not show any signs of depletion but remain as rich as when the work first began. The most important beds are, for the conchologist, the one at Half Pone Bar, where the smaller and rarer species are specially abundant, and for the button man the one at Guisers Bar, which has yielded rich returns through a long series of years; in fact, from the very beginning of work here on the river.

Fourth section, Dover to Smithland, Ky., 85 miles.—While this section is not as well known as the preceding, and has not been worked as much, it probably contains as many and as valuable mussels.

The center of demand was still the blank factory at Clarksville, to which all the shells have to be transported up the river. But a sort of secondary center has been established at Dover, Tenn., where Mr. Walter, one of the leading merchants of the town, purchased most of the local shells and hired most of the clammers. Furthermore, the business in this part of the river was conducted in the most approved and up-to-date manner. The boats were towed to and from the mussel beds by small launches, the mussels themselves were conveyed from the boats up the steep river bank by steam power, and were finally cleaned by steam conveyed to the pans in a pipe from the engine.

FOURTH SECTION, DOVER TO THE OHIO RIVER.

Mussel beds.	Percentage of commercial shells.						Percentage of culls.			Conditions.			
	Muckets.	Pigtoes.	Niggerheads.	Sand-shells.	Washboards.	Warty-backs.	Spikes.	Pinks.	Small or thin shells.	Size of bed.	Kind of bottom.	Temperature of air.	Temperature of water.
												°*F.*	°*F.*
Elk Creek Shoals	....	77	11	....	1	3	....	4	3	Large	Gravel	....	....
Walters Camp	5	10	25	10	5	15	....	6	5	...do	...do	....	....
Ball Island	....	70	9	....	8	2	3	3	5	...do	...do	....	....
Glasgow Landing	....	66	12	....	....	6	....	14	....	...do	...do	....	....
Dover Island	....	70	14	....	8	4	....	....	....	...do	...do	95	79
Jones Landing	....	70	6	8	6	5	1	2	....	...do	...do	84	78
Linton, Ky	....	76	10	6	....	5	....	2	....	...do	...do	85	75
Donelsons Landing	....	56	15	4	8	7	2	4	....	...do	...do	92	76
Canton, Ky	4	54	25	5	5	5	....	2	....	...do	...do	84	74
Eddyville Bar	....	26	26	....	34	6	....	6	....	...do	Rocks	86	73
Kuttawa, Ky	2	21	45	....	17	4	....	4	5	...do	Gravel	....	....
Money Cliff	....	9	51	....	37	....	....	2	....	...do	...do	....	....
Mussel Shoals	....	20	62	....	6	5	....	3	3	...do	...do	....	....

Mussel Shoals was the lowest point visited on the river, but from reports given by the clammers the niggerhead continues to be the prominent shell down to the mouth of the river.

The number of beds in this section of the river is fully equal to that of the preceding section, but they have not been worked as much because they are farther away from the center of demand and require transportation up the river to Clarksville. The niggerhead gains steadily in its percentage and at Canton passes the pigtoe, and then continues to increase down to the mouth of the river. There is also a steady decrease in the amount of culls, until at and below Canton nearly all the shells obtained were marketable. Of course, this means much to the clammer, as it does away with the necessity of sorting the shells and handling over the culls.

TABULAR STATEMENT OF DISTRIBUTION OF SPECIES.

In the table herewith given is expressed the distribution of every species of mussels obtained by the party in the Cumberland River and its tributaries. Where the mere presence of a species is all that is desired, it is indicated by an X. The percentages of the more important commercial species are indicated by numbers. The totals represent the actual number of specimens obtained. In order to catch the eye readily, all the side stations not on the main river are printed in italics. All commercial species are marked with an asterisk (*).

DISTRIBUTION OF MUSSEL SPECIES IN CUMBERLAND RIVER AND TRIBUTARIES.

	Species.	*Clear Fork, Jellico, Tenn.*	*Clear Fork, Savoy, Ky.*	Cumberland, Pineville, Ky.	Cumberland, Barbourville, Ky.	Cumberland, Williamsburg, Ky.	*Laurel Creek, Corbin, Ky.*	*Rock Castle River, Livingston, Ky.*	Cumberland, above falls.	Cumberland, below falls.	*Big South Fork, Parkers L. Station.*	*Big South Fork, above Burnside.*	Main River, Burnside.	Cumberland, Fishing Creek.	Fords Island.	Mill Springs Bar.	Below Eadsville.	*Beaver Creek.*	Indian Creek Shoals.	Snows Island.	Tear-coat Bar.	Selfs Bar.	Champs Shoals.
1	Truncilla triquetra (snuffbox)																			1			
2	brevidens										2	×						×					
3	arcæformis											×											
4	sulcata (cat's claw)																						
5	haysiana (acorn)										2	×				×							
6	capsæformis										6	×				1			×				
7	florentina																		×				
8	walkeri, sp. nov																						
*9	Lampsilis ventricosa (pocketbook)																						
10	ovata (pocketbook)			×		×		3	×	6	3	×				9	9	×	5		1	3	
11	multiradiata							2		2	4	×	4				×	×	×			×	
*12	ligamentina gibba (southern mucket)									24	5	7	30	×		5	22	×	40	5	40	40	35
*13	orbiculata															1			1				
14	tæniata																						
15	picta							1				×											
16	punctata							1			×	×	2					×					
17	perdix							4		9		6	2		10		2	×					
*18	anodontoides (yellow sand-shell)																						
*19	fallaciosa (slough sand-shell)																						
*20	recta (black sand-shell)							1		1	4	3				1			2	1		×	
21	lienosa									×													
22	vanuxemensis																						
23	trabalis									5	2		2			2							
24	parva																						
25	glans																						
26	alata (pancake)									1	×	×				4	2	×	1			×	
27	gracilis (paper-shell)										×					×							
28	lævissima (paper-shell)																						
29	leptodon																						
30	Medionidus conradicus							31		×	1												
31	Obovaria retusa																						
32	circula										2					14		×					
*33	ellipsis (Missouri niggerhead)																			14			
*34	Plagiola securis (butterfly)									×		×	2	×		4	2		2	×			×
35	elegans (deer-toe)									2		×				2				1			
36	donaciformis																	×					

37	Cyprogenia irrorata																2					×	
*38	Obliquaria reflexa (three-horned warty-back)									1		×				9	2		×	1			
39	Ptychobranchus phaseolus (kidney-shell)							1		10	1	2	2		10	1	4				1		
40	subtentus							4		×	12	2							×				
41	Dromus dromas												4	×		1	7		1	6	4	2	
42	caperatus (fan mussel)										5	×											
43	Strophitus edentulus schæfferiana	1					3	1			×	×	2							1			
44	Anodonta imbecillis																						
45	grandis (floater)																						
46	Lastena lata											×											
47	Anodontoides ferussacianus	1		×			3																
48	Pegias fabula							2															
49	Symphynota costata (fluted shell)						3	8		5	1	×						×	×				
50	complanata (heelsplitter)																						
51	Alasmidonta minor	27	1	×	×		28		×														
52	truncata (elktoe)							2				×	2				2						
53	Margaritana monodonta (spectacle-case)														20					13			
54	Unio gibbosus (spike)	71	99	×	×	×	63	33	×	15	26	29	16			1	2	×	×	1			×
55	crassidens ("pink," elephant ear)									7	15	5	28	×	60	14	20		40	39	50	50	60
56	Pleurobema clava (club-shell)							1			1	×											
57	crudum										×	×											
58	æsopus (bullhead)																2					×	
*59	Quadrula tritogonia (buck-horn)							2		4		×				1	7	×		1	×	×	
*60	perplicata (round-lake)							1								1	2	×				×	×
*61	undulata (three-ridge)																						
*62	heros (washboard)															1							
63	cylindrica (rabbit's-foot)							1			×	×				1		×					
*64	metanevra (monkey-face)															1		×	×	4			×
65	tuberosa																					×	
66	fragosa																						
*67	pustulosa (warty-back)									6	×					7	2		×	1			
*68	cooperiana (Cumberland pigtoe)															1				×	1		
69	rubiginosa (Wabash pigtoe)																						
*70	undata (pigtoe)																						
*71	obliqua (Ohio River pigtoe)											?				×	2	×	×	9			×
72	coccinea							2			9	6	4			×		×	×		×		
*73	solida															4	2		×		×	×	
74	plena													×		×	×		×		×	×	
75	pyramidata											×				4	×				×	×	
*76	subrotunda										1	×											
*77	ebena (niggerhead)															×							
78	tuberculata (pink warty-back)									×	×	×				5		×	×			×	
79	granifera (pink warty-back)															2							
	Total number specimens obtained	70	200	×	3	10	35	458	×	810	389	275	50	×	100	77	45	×	×	76	×	×	×

DISTRIBUTION OF MUSSEL SPECIES IN CUMBERLAND RIVER AND TRIBUTARIES—Continued.

	Species.	Biggerstaff Bar.	Butlers Landing.	*Roaring River.*	Salt Lick Island.	Goodall Island.	Beasleys Shoals.	Cedar Bluffs.	Puryear Bar.	Lindsleys Island.	End Lindsleys Bar.	Hills Island.	*East Fork Stones River.*	*West Fork Stones River.*	Foot Gowers Island.	*Harpeth River.*	Half Pone Bar.	Seven-mile Ferry.	Owl Hollow Bar.	Guisers Bar.	Clarksville.	*West Fork Red River.*	Red Rock Bar.
1	Truncilla triquetra (snuff-box)				×	22																	
2	brevidens																						
3	arcæformis																						
4	sulcata (cat's claw)					×											1						
5	haysiana (acorn)				2	×															×		
6	capsæformis				3																		
7	florentina																×						
8	walkeri, sp. nov												70										
*9	Lampsilis ventricosa (pocketbook)												1			×					×		
10	ovata (pocketbook)		×		3	×		×		×		×			×		×	×		×			
11	multiradiata			18									2	2	×	×						×	
*12	ligamentina gibba (southern mucket)	10	×		6	×	×	×	2	×		×			×		×	3	×	×			×
*13	orbiculata		×		3	×	×			×		×			×			×					
14	tæniata													26									
15	picta			15																			
16	punctata			2																			
17	perdix																						
*18	anodontoides (yellow sand-shell)										×	×			×	×	1	7		1	×		1
*19	fallaciosa (slough sand-shell)											×					1						
*20	recta (black sand-shell)		×				×	×							×	×	×			×			
21	lienosa												×								×		
22	vanuxemensis																					×	
23	trabalis																						
24	parva												×										
25	glans			10									×	2								×	
26	alata (pancake)	2	×		3	×	×	×				×			×		×	×		1	×		×
27	gracilis (paper-shell)				1	×			1	×		×			×		1		×	×	×		×
28	lævissima (paper-shell)															×							
29	leptodon																						
30	Medionidus conradicus			53									×										
31	Obovaria retusa	2			1	×	×					×					×			×			
32	circula	2			4								2				×						
*33	ellipsis (Missouri niggerhead)	2						×	1	×	×		×		×		3	7	×	2	×		1
*34	Plagiola securis (butterfly)	33	×		6	×	×	×	4	1	×	×			×		8	10	×	3			3
35	elegans (deer-toe)								1	×					×		6		×		×		
36	donaciformis				1					×					×	×	33		×		×		

37	Cyprogenia irrorata					×				×								×	×	×			
*38	Obliquaria reflexa (three-horned warty-back)				14	×	×	×		×	×	×			×		10	×	×	2	×		1
39	Ptychobranchus phaseolus (kidney-shell)	6				×	×	×			×				×		×						
40	subtentus																						
41	Dromus dromas		×			×	×	×	1	×					×			×					×
42	caperatus (fan mussel)																						
43	Strophitus endentulus schæfferiana					×		×									×						
44	Anodonta imbecillis												×	2									
45	grandis (floater)												1	26									
46	Lastena lata	2															×						
47	Anodontoides ferussacianus			1																			
48	Pegias fabula																						
49	Symphynota costata (fluted shell)	2	×	1				×					8	27	×	×						×	
50	complanata (heelsplitter)															×							1
51	Alasmidonta minor																						
52	truncata (elktoe)					×																	
53	Margaritana monodonta (spectacle-case)										×				×		×						
54	Unio gibbosus (spike)	2	×		1	×	×	×	1	×		×			×	×	1	14	2	1			3
55	crassidens ("pink," elephant ear)	18	×		17	×	×	×	3	×		×			25		2	×	8	8			5
56	Pleurobema clava (club-shell)																						
57	crudum																						
58	æsopus (bullhead)	×			1		×			×		×					×	×		×			
*59	Quadrula tritogonia (buck-horn)	2				×		×		×		×			×	×	1		×	1			×
*60	perplicata (round-lake)	×	×		1		×	×		×	×	×			×		3	21		1			5
*61	undulata (three-ridge)												5	15	×								
*62	heros (washboard)		×		1	×		×		×	25	×			×		2	24	×	8			
63	cylindrica (rabbit's-foot)					×				×							6	×			×		4
*64	metanevra (monkey-face)	3	×		3	×	×	×	6	1	×	×			×		2	3	7	4	×		
65	tuberosa																						
66	fragosa									×					×	×	2	3	1		×		1
*67	pustulosa (warty-back)	10	×		1	×		×	2	1	×	×			×	×	7	×	×	1	×		1
*68	cooperiana (Cumberland pigtoe)	2	×		1	×	×	×	2	×	×	×							1	1	×		1
69	rubiginosa (Wabash pigtoe)												5										
*70	undata (pigtoe)															×							
*71	obliqua (Ohio River pigtoe)	×	×		3	×	70	×	35	95	50	80			50		6	×	59	50			65
72	coccinea?																						
*73	solida		×		2					×								×	×				
74	plena							×							×		×	×					
75	pyramidata							×		×		×											
*76	subrotunda	×						×	1	×					×		×	×					×
*77	ebena (niggerhead)						×	×	1	×	×	×			×		1	7	8	8			6
78	tuberculata (pink warty-back)		×			×	×	×	4	×	×				×			×	3	3			
79	granifera (pink warty-back)																×						
	Total number specimens obtained	61	×	96	100	×	×	×	65	1,680	×	×	194	146	×	×	903	29	163	271	×	×	286

DISTRIBUTION OF MUSSEL SPECIES IN CUMBERLAND RIVER AND TRIBUTARIES—Continued.

	Species.	Trices Landing.	Above Meeks Bar.	Meeks Spring Bar.	Haynes Lake.	Elk Creek Shoals.	Walters Camp.	Above Ball Island.	Below Ball Island.	Glasgow Landing.	Head Dover Island.	Foot Dover Island.	Jones Landing.	Linton, Ky.	Mouth Donelson Creek.	Below Canton, Ky.	Eddyville Bar.	Above Kuttawa, Ky.	Below Money Cliff.	Horse Ford, below Kuttawa.	Penitentiary Bar.	*Red River, Port Royal.*	*Caney Fork.*
1	Truncilla triquetra (snuff-box)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2	brevidens	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×
3	arcæformis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
4	sulcata (cat's claw)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5	haysiana (acorn)	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
6	capsæformis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×
7	florentina	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
8	walkeri, sp. nov	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
*9	Lampsilis ventricosa (pocketbook)	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10	ovata (pocketbook)	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....	×	3	....	....	×	×
11	multiradiata	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
*12	ligamentina gibba (southern mucket)	....	....	....	....	....	×	....	....	....	....	....	....	×	....	1	....	....	....	....	....	×	×
*13	orbiculata	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
14	tæniata	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
15	picta	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
16	punctata	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
17	perdix	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....
*18	anodontoides (yellow sand-shell)	....	8	....	....	....	×	....	....	....	....	....	....	....	....	....	1	....	....	....	×	×	....
*19	fallaciosa (slough sand-shell)	....	1	....	....	....	....	....	....	....	....	×	8	....	....	×	....	1	....	1	×	×	....
*20	recta (black sand-shell)	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	1	1	....	×	×	....	....
21	lienosa	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
22	vanuxemensis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
23	trabalis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
24	parva	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25	glans	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
26	alata (pancake)	....	2	....	....	....	×	....	....	×	2	×	×	×	....	....	....	1	....	×	....	×	....
27	gracilis (paper-shell)	....	1	×	....	....	....	....	....	....	....	×	....	....	....	....	....	×	....	×	....	....	....
28	lævissima (paper-shell)	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
29	leptodon	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30	Medionidus conradicus	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
31	Obovaria retusa	....	....	....	....	....	....	1	....	....	....	1	....	....	....	×	....	....	....	×	....	....	....
32	circula	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....
*33	ellipsis (Missouri niggerhead)	....	5	×	....	....	....	1	3	....	....	1	1	....	2	1	....	×	....	....	×	....	....
*34	Plagiola securis (butterfly)	....	3	....	....	2	....	1	....	×	6	....	....	×	2	4	....	×	....	×	....	....	....
35	elegans (deer-toe)	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
36	donaciformis	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

37	Cyprogenia irrorata																						
*38	Obliquaria reflexa (three-horned warty-back)		19			1		3		×	6	3	1	1		1				×	×		
39	Ptychobranchus phaseolus (kidney shell)																					×	
40	subtentus																						
41	Dromus dromas																						
42	caperatus (fan mussel)																						
43	Strophitus edentulus schæfferiana								3													×	
44	Anodonta imbecillis				8																		
45	grandis (floater)				92																		
46	Lastena lata																						
47	Anodontoides ferussacianus																						
48	Pegias fabula																						
49	Symphynota costata (fluted shell)																					×	
50	complanata (heelsplitter)																					×	
51	Alasmidonta minor																						
52	truncata (elk-toe)																					×	
53	Margaritana monodonta (spectacle-case)						×																
54	Unio gibbosus (spike)	4					×		3			1	×	1	2						×	×	
55	crassidens ("pink," elephant ear)	7	1	4		4	×		3	14		4	1	1	4	2	4	6		3	×	×	
56	Pleurobema clava (club-shell)																						
57	crudum																						
58	æsopus (bullhead)					1			3	×	2												
*59	Quadrula tritogonia (buck-horn)		4				×	3	3				×					×				×	
*60	perplicata (round-lake)		1			1		6		×	2		2			2	1	×		×	×	×	
*61	undulata (three-ridge)																						
*62	heros (washboard)	4	1	4		2	×	8			8	3	7	4	4	×	34	17	37	5	×	×	
63	cylindrica (rabbit's-foot)		3	×																			
*64	metanevra (monkey-face)		4	4		2	×	3	7	2		10	1	×	4	6	1	2		1	×		
65	tuberosa																						
66	fragosa	4	38	×								4	×	×		1	4	1	9	×			
*67	pustulosa (warty-back)		4			1	×	3		2		6	2	1	4	1	1	1			×		
*68	cooperiana (Cumberland pigtoe)			2			×	3	3					×	2	2				×			
69	rubiginosa (Wabash pigtoe)																						
*70	undata (pigtoe)		1			1								×			1	1					
*71	obliqua (Ohio River pigtoe)	53	1	74		77		60	72	67	70	58	70	76	56	49	26	20		20	×		
72	coccinea?																						
*73	solida																						
74	plena																						
75	pyramidata																						
*76	subrotunda																						
*77	ebenus (niggerhead)	28	2	7		6	×			12	2	12	6	10	13	23	26	45	51	62			
78	tuberculata (pink warty-back)						×	6		2					7	2					×	×	
79	granifera (pink warty-back)																						
	Total number specimens obtained	28	156	×	27	93	×	69	38	56	51	73	365	328	45	79	143	269	35	181	×	×	

RELATIVE ABUNDANCE OF DIFFERENT SPECIES.

In forming an estimate of the relative abundance of the different mussels in the various beds many things have to be taken into consideration.

For the clammer's purpose, a count of his entire catch would give the most reliable data, but this is usually impossible. It is almost as satisfactory to take the successive hauls as they come and count the various species in each; the greater the number of hauls counted the more accurate the results obtained.

From the viewpoint of the conchologist, however, such an estimate is in reality only a measure of the extent to which the species in question is capturable by the clammer's gear, and for the following reasons:

There are a number of species which never "bite" the hooks on a crowfoot dredge, or which do so very rarely. Such species may be plentiful in a mussel bed and yet never appear in the clammer's hauls.

Again, some mussels are found only in small numbers and around the edges of a bed. The clammer makes his hauls where the shells are most crowded, through the center of the bed, and may miss these altogether.

The clammer throws away the mussels that are too small to use as well as those whose shells are too thin or too highly colored. Such shells ought to enter into the percentages as much as the more valuable species, but they do not appear in the clammer's hauls.

Different methods of clamming produce very different results in the proportion of shells obtained. The crowfoot dredge, the rake, the tongs, and wading each secure an unduly large number of some species and an unduly small number of other species.

To enumerate all the shells obtained by all the methods would give the most accurate results, but that is obviously impracticable. When the water is low the clammer gets quite a different proportion of species, and may even get different kinds of mussels from those obtained when the water is high.

Each of these considerations has been kept in mind while making out the percentages; the clammer's hauls were counted; all the piles of culls were carefully examined; all the specimens possible were secured by wading along the edges of the beds; account was taken of the various shells found in muskrat piles; the relative stage of water was noted, and, so far as could be done, allowance was made for it. Then, too, there has been a careful consideration of numerous circumstances which can not be shown to the reader, but which result from the authors' experiences at the different stations. Notwithstanding all these efforts, the numbers must still be regarded as

approximate rather than absolute. But, even so, they will be of service to the mussel fishermen, for whom they are primarily intended. Only a very small percentage of the shells seen and handled could be kept for the final collection.

An endeavor was made to retain typical specimens of each species encountered, and also all puzzling and aberrant forms, since the latter add much to the actual knowledge of a species, though they may render positive identification more difficult.

SUMMARY OF MUSSEL DISTRIBUTION.

The practice of the Bureau of Fisheries in examining a river and its tributaries from source to mouth, in regular order, throws unexpected light on the distribution of species which could be obtained in no other way. The fauna of a river has a coherence never found and not to be expected in an artificial division of the country, such as a township, county, or State, whose boundaries are purely arbitrary. The larger the river and the more thoroughly the main stream and its tributaries are examined the more illuminating become the results. The study of the entire fauna of the Cumberland River and its tributaries leads to the following general conclusions, which are amply confirmed in all the river faunas that have been examined:

1. When two closely related forms differ essentially in their degree of inflation, the flatter and less inflated one will be found in the upper portions of the river and in the tributaries, while the rounder and more inflated one is confined to the lower portions of the main river, where there is a weaker current and more mud. To this there are, however, some noteworthy exceptions, such as *Symphynota complanata*.

2. The swiftness of the current, the size of the stream, and the kind of bottom affect other shell characters besides that of inflation. Consequently, where there is a mixture of conditions there is also a mixture of characters, and two species which in other localities may be well defined and easily separated will be found to merge imperceptibly into each other. In a miscellaneous collection of shells it is easy to find the blue-point (*Quadrula undulata*) from one stream and the three-ridge (*Q. plicata*) from another, the southern mucket (*Lampsilis ligamentina gibba*) from one locality in a State and the pocketbook (*L. ventricosa*) from another. But when specimens of the entire fauna of a river are spread out on a table in order from the source to the mouth there is found such a mingling of characters that it is often a mere matter of individual judgment to determine some of the species. This is essentially true of *Q. undulata* and *Q. perplicata* in the upper portions of the Cumberland.

3. There is sometimes a peculiar similarity in the faunas of widely separated tributaries, where the conditions at first would seem to be

very different. Such a similarity is found in Roaring and Rock Castle Rivers, although the localities are widely separated and the surrounding country quite different.

4. Some species demand peculiar conditions, and their presence or abundance in any locality depends on the presence and extent of the favorable conditions.

The washboard (*Q. heros*) lives in holes or depressions in the bottom, full of soft mud. Any mussel bed in the Cumberland that has such holes will be likely to contain washboards, whether that bed is high up the river or low down toward the mouth, and the percentage of the washboards will depend on the area covered with such holes.

5. The Cumberland is very different from the Maumee and Kankakee Rivers in that it shows a marked differentiation between small and large stream species, between the main river and its tributaries, but there is very little evidence of migration along the main river itself.

Such species as are confined to the upper, middle, or lower portions of the river owe their habitat chiefly to the fact that here, as elsewhere, they frequent smaller or larger streams, as the case may be.

Accordingly, we may distinguish the following classes:

(*a*) Small-stream species restricted to the upper portions of the river and its tributaries. Here belong seven species. *Anodontoides ferussacianus* was found only in the tributaries and not at all in the main river. The other six species, *Lampsilis perdix*, *multiradiata*, *orbiculata*, and *punctata*, and *Alasmidonta minor* and *truncata* are distributed in various tributaries and in the main river both above and below the falls. None of these are commercial species.

(*b*) Large-stream species, restricted to the lower portions of the main river. There are nine of these species, seven of which are not found in any of the tributaries, viz: *Lampsilis ventricosa* and *fallaciosa*, *Obovaria retusa* and *ellipsis*, and *Quadrula heros*, *ebena*, and *fragosa*. The other two species, *Lampsilis anodontoides* and *Quadrula undata*, were found in Harpeth River and the former also in Red River as well as in the main Cumberland. The most of these large-stream species are good button shells, as would be expected. Indeed, the only exception is *Obovaria retusa*, which is the smallest of them all and for that reason the least valuable.

(*c*) Species of universal distribution, which are well scattered throughout the entire length of the main river. There are seven of these species, three of which, the Ohio River pigtoe (*Quadrula obliqua*), the pink warty-back (*Q. tuberculata*), and the butterfly (*Plagiola securis*), are not found in any tributary. The other four are the southern mucket (*Lampsilis ligamentina gibba*), the pocketbook (*L. ovata*), the spike (*Unio gibbosus*), and the elephant-ear

(*U. crassidens*). The last two, of course, are culls, but all the others are valuable commercial shells.

(*d*) Species confined to restricted areas, including all of the rare forms that are of interest chiefly to the conchologist. These include all of the Truncillas, which were found in places widely separated from one another, and one of which was new to science; nine species of *Lampsilis—tæniata, picta, ligamentina, vanuxemensis, trabalis, parva, glans, lævissima*, and *leptodon*—all of which are too small or too thin-shelled to be of any value. *Dromus caperatus* and *Symphynota complanata;* two *Anodontas, imbecillis* and *grandis;* two Pleurobemas, *clava* and *crudum;* and four Quadrulas, *undulata, tuberosa, rubiginosa,* and *granifera*. These last four have some commercial value but not very much.

6. The great bulk of the mussel fauna of the river is thus made up of the seven universally distributed species, and two of the large stream mussels—*Quadrula heros* and *Q. ebena*. All the others are confined to such restricted areas or occur in such small numbers as to possess only an incidental or accessory value.

NOTES ON THE VARIOUS STATIONS.

THE UPPER RIVER AND ITS TRIBUTARIES.

This portion of the river was examined by Mr. Boepple in 1910 as well as by the present party in 1911. Both the river and its tributaries are rather swift mountain streams which are much used as a source of power to run small gristmills, and hence they are frequently interrupted by dams. The bottom is mostly bedrock sandstone, with occasional fissures and sand and gravel pockets and bars, the latter furnishing the only localities where mussels can live. Consequently the shells are very few in number and widely scattered. The Clear Fork has more sand bars and pockets than the main river, and hence considerably more mussels.

Mr. Boepple in his notes called attention to the apparent presence of acids in the water above the great falls, which quickly dissolved the nacre of dead shells, and the present party observed the same thing. Moreover, in the small beds above the falls the muskrats had made considerable inroads into the mussel fauna. Against so many unfavorable conditions the mussels find it very hard to hold their own, and the few species able to survive are not of any importance either to the pearlers or the button manufacturers. These mussels above the falls are not only thin-shelled but are much dwarfed, and *Unio gibbosus*, the most common species, has a very pale nacre, which frequently becomes white or yellowish and approaches closely a dwarfed form found in Green River, Ky.

THE RIVER BELOW THE FALLS AND ITS TRIBUTARIES.

Not only were there a great number of additional species below the falls, but there was also a change in the character of the shells. This was especially noticeable in *Unio gibbosus*, which was no longer a pale-nacred dwarf, but was of normal size and color. The mussels are usually found crowded about the base of the large rocks along the bottom of the river just below the falls. They are easily accessible to their enemies, especially during low water, and many of them are killed by muskrats, raccoons, mink, and occasional otter. But the relative number lost in this way is very small when compared with the corresponding loss above the falls. Hinge pearls (baroques) are common in this portion of the river, especially in the pocketbook (*Lampsilis ovata*), nearly every specimen of which contains a few. The river from Anvil Shoals, 1 mile below the falls, to Burnside was not investigated either by Mr. Boepple in 1910 or by the present party in 1911, but it was reported by a mussel fisherman to be full of excellent button shells. The bottom is much too stony for any kind of gear, however, and it would be necessary to collect the mussels entirely by hand. Pearling has been conducted actively along this portion of the river, and piles of shells left by the pearlers were frequent along the shore. Indeed it was reported that pearling had practically cleaned out the river for the first 10 miles above Burnside. There are two tributaries, both from the north, which enter the Cumberland in this space between the falls and Burnside.

Rock Castle River is the larger of the two and is nearer Burnside. It was examined below the ford at Livingston, Ky., July 1. The shores here were high and rocky and were forested with a mixture of deciduous trees and hemlock. The water was clear, temperature 81°, with a maximum depth of a foot and a half. The current was slow (2 miles per hour) and the bottom was very rocky and rough, with only a few bars and patches between the rocks filled with clay. The flora was remarkable and wholly unlike any that we saw elsewhere. Nuphar grew along the water's edge, *Myriophyllum verticillatum*, a broad-leaved *Potomogeton*, and a small patch of *Scirpus americanus* grew in the shallow water, and there was plenty of water willow, the whole reminding one of a bit of creek in northern Indiana or Illinois. The mussels were excessively abundant in the sand and clay patches here, and in favored localities the little *Medionidus conradicus* covered the entire bottom with the elongate slits, which is all of the mussel that can be seen.

Nineteen kinds of mussels were found here, but only a very few of them possessed commercial value, and a few miles farther down the river all the species were widely scattered. This shell bed was markedly unlike any of those in the main river, containing some

species that were not found in the Cumberland at all, and others that were quite rare. In these respects they resemble those found in Roaring River in Tennessee.

Laurel Creek, a tributary of Laurel River, was examined below the dam at Corbin, Ky., July 3. The shores were rocky and were heavily wooded with a deciduous forest, mixed with hemlock and pine, and still supported a remarkably rich and varied flora. The dam cuts off the upper portion of the river, and no mussels were found above it. There was a city dumping ground near at hand and the water was milky in color and covered with a greasy scum. Below the dam the bottom was very irregular and mostly solid rock, full of potholes and patches of sand and destitute of vegetation.

We had expected to find a rich and varied fauna, something like that of the Rock Castle River, but could discover only five species, and three of these were represented by a single shell each. This river thus has almost identically the same species as the Clear Fork and the Cumberland above the falls. The poverty of species is doubtless due to the smallness of the stream and the general unsuitable conditions.

There was no dwarfing of the species, but there were several peculiar modifications in the color of the nacre which were not found in the main river. These suggest that while there is some intercourse with the Cumberland there is very little interbreeding.

The Big South Fork flows into the Cumberland at Burnside, Ky. Our party examined it first opposite Parkers Lake, where there is a fish trap and a low dam. The shores there were high limestone cliffs, the water was very clear, and the bottom was coarse gravel covered with bowlders and great angular fragments of rock, with some sand between them. Dead shells, recently killed by muskrats, were abundant on the rocks and on the dam at the fish trap. Twenty-eight species were obtained here, but although seven or eight of them were good button shells, they were not sufficiently abundant to make the gathering of them profitable. At Sloans Shoals, 6 miles from Burnside, during the autumn of 1910, Mr. Boepple found about 20 species, securing them all with a rake. At the riffles, 2 miles above Burnside, the present party found large but rather scattered beds of mussels, by far the greater number of which were noncommercial. There were 32 species in all, and evidently some of them had yielded good returns in pearls, for there were many piles of shells along the river bank and the bed had been thoroughly worked over.

Minute marginal cysts were abundant in the edge of the mantle of *Unio gibbosus*, often leaving small pits along the margin of the shell. Baroques and the distomid of Kelly were found in *Quadrula tuberculata*, and a few large *Atax* in *Symphynota costata*. Several of the *U. gibbosus* and two of the *Pleurobema* were gravid. The latter

had fine red eggs in all four gills and the body was orange; the former had coarse white glochidia in only one pair of gills.

On proceeding down the main river from Burnside the first mussel bed of note is on the bar below the mouth of Fishing Creek. Very few living mussels were seen here, but the entire river bed was covered with shells which had been killed by pearlers. A large number of beautifully marked univalves were present among the dead mussel shells.

At Fords Island the bottom of the left chute, which we examined most carefully, is a shingly gravel, in which it was difficult to find the mussels. Mr. Boepple, who examined this bed in 1910 with a mussel rake, reported an "almost unbelievable quantity" of *Unio crassidens*. The present party would probably have obtained many more mussels if the bed could have been examined during low water.

Four miles farther downstream, at Mill Springs, is another long and straggling mussel bed, which covers several miles of the river bottom. The latter is here composed of shingly gravel, with some sand bars, and is largely covered with water-willows.

The pearlers' piles along the banks opposite this bed were chiefly the shells of *Unio crassidens* (elephant-ear) with some *Dromus* and *Quadrula obliqua* (Ohio River pigtoe). Although this was not an important shell bed it was noteworthy for the increase in the number of species. The pocketbooks (*L. ovata*) found here were the first typical ones seen.

At the pearling camp 1½ miles below Eadsville or Lock 21 we found the water about 2 feet above normal and rising rapidly, with a swift current over a gravel bottom. The pearlers were farmers from near by, who carried on pearling at odd times. They had thrown their opened shells back into the river, and there were about a ton and a half of them lying in the shallow water along shore. The pocketbooks (*L. ovata*), muckets, and elephant-ears were the most numerous species. Mr. Boepple investigated Gands Island, in this vicinity, and found the mussels, especially *Unio crassidens*, abundant on both sides of the island, an unusual circumstance.

Beaver Creek is a small tributary of the Cumberland from the south, opposite Rowena, Ky. This creek was investigated for a mile, up to a series of long riffles. The bottom was rocky with considerable mud and sand, in which were obtained a surprising variety of shells for so small a stream, as is shown in the table.

In the mouth of Goose Creek, a little way down the river, a man was seen actively pearling with a fork. He said that he was getting mostly elephant-ears and that there were plenty of muckets on the other side of the river but the water was too high to work them. Mr. Boepple saw a fine lot of about 50 pearls in Rowena during his stop there in 1910.

Indian Creek Shoals, 53 miles below Burnside, is one of the most interesting mussel beds of the upper river. We found the water clear with a swift current over a gravelly bottom. Near the water's edge was a pile of about 300 pounds of shells left by a pearler. These were mostly pocketbooks and muckets, but contained a good sprinkling of sand-shells, *Dromus*, and monkey-faces. Mr. Boepple obtained a good collection of shells from this bed in 1910 and also from Copper Island a little farther down the river.

Snows Island is a large island covered with coarse pebbles, upon which many dead shells had drifted, while others along the shore had been freshly killed by muskrats. At the head of Weeds Island, a little way below, there was about a ton and a half of shells left by pearlers, chiefly the southern mucket and elephant-ear.

At Tear-coat Bar on July 20 the water was muddy and high from a heavy rain the night before. The bottom here is black gravel mixed with yellow sand. Out of a ton and a half of shells left here by pearlers about 90 per cent were southern muckets and elephant-ears and the remaining 10 per cent an admixture of other species.

Selfs Bar contained a large and populous mussel bed which had been the center of active pearling operations. The 3 tons of shells left by them contained about the same percentage of shells as at Tear-coat Bar.

Marrowbone Creek, a small tributary from the north, was examined up to the first riffles, a mile or more, but contained no mussels. In general the northern tributaries of the Cumberland were rather barren, while those from the south were well populated. On the top of a hill near the mouth of this creek was an old shell pile left by the Indians, and from this point these shells became quite frequent, especially near the sites of old camping grounds.

At Champs Shoals pearling was being actively carried on, and there was a large pile of discarded shells, two-thirds of which were elephant-ears, while nearly all of the other third were southern muckets. The river here widens out considerably, and there is more clay and sand on the bottom. The shell bed continues with some interruptions from this bar down to Burkesville. At Tobins Landing, below Burkesville, Mr. Boepple obtained a fine collection of shells, representing at least 14 species.

At Cloyds Island, below Tobins, there is an unusually good mussel bed which has been much worked by pearlers. The banks along both sides were fairly covered with the shells left by them, principally southern muckets and elephant-ears. In this bed the mussels were thickest where the current was strongest.

Biggerstaff Bar and Island were examined July 24; at the head of the island were a few shells among which were found specimens of *Lastena lata*, a rare species.

A few rods below the bar there were several good-sized shell piles left by muskrats, from which we obtained an exceptionally fine lot of butterfly-shells (*P. securis*). From Martinsburg to Celina there were a few pearlers' piles which increased in size and number of shells as we approached the latter place.

The Obey River, a tributary from the south which enters the Cumberland at Celina, Tenn., and the Cumberland itself in the vicinity of Celina, were examined by Mr. Boepple in 1910 and again in 1911. He covered the lower 26 miles of the Obey River, beginning at Grass Lot Shoals, where no mussels were found. At Martins Bar a large collection was obtained representing 22 species, of which the southern mucket and the pocketbook were the most abundant. The bottom here was firm coarse gravel. At Holmes Bar 24 species were secured, the southern mucket being still the most abundant. The current was swift and the coarse gravel bottom was covered with a rich vegetation, in which the mussels were especially abundant. The southern mucket is the only shell in this river worthy of commercial consideration, the others being too scarce. Mr. Boepple estimated that when niggerheads are worth $30 per ton these muckets would be worth $50.

From 12 to 15 years ago there was considerable pearl fishing on the Obey River, and a local firm said that then one could easily get a wagonload of mussels a day. But now the larger mussels are gone and the small ones have only small pearls. Fourteen of these pearls which were examined weighed from 2 to 4 grains each, but were of extra quality.

In the Cumberland, 1 mile below Celina, there is a fair-sized mussel bed which has been worked for 10 years, entirely for pearls. The most valuable commercial species is still the southern mucket, and this is also regarded as the best pearl bearer.

Mr. Boepple examined a large bed near Butlers Landing and secured 13 species, but the specimens were all too badly eroded and spotted to have any commercial value. A storekeeper here had a number of pearls which he had taken in trade, and he showed us an assortment of 4 purple, 5 yellow, and 8 white ones, of the rosebud type, all of which had an exceptionally good luster.

About 3 miles below Butlers Landing we found the first pile of commercial shells we had seen, but they were all old shells, since no active clamming had been carried on for two years. There were 6 or 7 tons in the pile, most of them of second quality, the Ohio River pigtoe being the most common, with the southern mucket and the Cumberland pigtoe (*Q. cooperiana*) close seconds. There were fully 2 tons of culls, 98 per cent of which were elephant-ears and the purple warty-back. Mr. Boepple secured a fine collection of shells from this bed with the crowfoot dredge, and among them were 3 specimens of

Lampsilis fallaciosa, the slough sand-shell, which were the first obtained during our survey of the river.

At Brimstone Island there is a large mussel bed in water from 2 to 8 feet deep, with a bottom of coarse gravel, sand, and clay. Commercial clamming had been in operation here only a few days before our arrival, but must have been carried on during previous years, as evidenced by a pile of button shells on the bank containing fully 20 tons.

At Carsons Bar there is another large mussel bed in water from 3 to 6 feet deep, with a moderate current and a hard gravel bottom. This bed is worked only occasionally by local fishermen chiefly for fish bait and pearls.

Roaring River, a tributary from the south which enters the Cumberland just above Gainesboro Landing, was examined several miles above its mouth on July 28. Only one small mussel bed was found along the shore under the shade of the overhanging trees, in 3 to 6 inches of water on a gravelly bottom. The presence of a large amount of *Potomogeton* and the abundance of *Medionidus conradicus* was a strong reminder of the Rock Castle River at Livingston, Ky. The abundance of *Lampsilis glans* was also noteworthy, since this species was not found anywhere in the main river.

At Gainesboro Bar there is a small mussel bed which can not be worked with a crowfoot dredge, since the bottom is composed of flat rocks with gravel pockets in the cracks. At the lower end of the bed, where the rocks were well covered with a blue clay, the mussels were of especially fine quality, but the bed has never been fished commercially.

We reached Salt Lick Island when the water was low and the mussels were moving about actively. Similar conditions were found at Half Pone Bar (see p. 33), and the extremely interesting collections obtained at each of these stations show what a remarkable difference a low stage of water makes in the results of collecting. There is no reason for supposing these two beds to be exceptionally good, and probably most of the beds in the Cumberland would have nearly if not quite equaled them if the conditions under which they were examined had been equally favorable. This Salt Lick Island bed was especially noteworthy for the large numbers of *Truncilla* that were obtained. No parasites were found on any of the mussels. *Lampsilis gracilis* was gravid (July 31), while *L. ligamentina gibba* and *L. orbiculata* approached each other so closely in all their shell characters as to be indistinguishable except by the color of the nacre and epidermis.

At Fort Blount Bar there is a large mussel bed in water from 4 to 6 feet deep, with a swift current over a bottom of firm gravel mixed with yellow clay and sand. Two men from the Ohio River had been

working here for a week before our visit, and two more began on the day of our arrival. The Ohio River pigtoe is the most common button shell.

At Granville our party was caught in a very heavy rain, almost a cloudburst, and went from there down to Carthage on high and turbid water which rendered any satisfactory mussel survey impossible.

Sullivans Island was investigated by Mr. Boepple when the conditions were more favorable. He found a large mussel bed in a strong current on a bottom of rough gravel and yellow clay. Although he secured 22 species, and among them a large number of Ohio River pigtoes and southern muckets, the bed is worked only for fish bait and pearls. Two small beds at Buffalo Bar and Sand Shoals are not of commercial value.

Caney Fork, one of the most important tributaries of the Cumberland, joins the latter river just above Carthage. In Buffalo Valley, near Flat Pond, July 27, Mr. Boepple found a mussel bed covering the entire width of the fork and 1½ miles long. He used a crowfoot dredge and scissors fork in water 5 to 10 feet deep on a bottom of coarse gravel mixed with sand and yellow clay. This bed has been fished for pearls and baroques during the last 15 years, and according to accounts it has yielded well. None of the shells have ever been sold, and fully a carload of merchantable species was seen scattered along the banks.

At Rock Springs there is a much smaller bed in a swift current, with water 2½ to 8 feet deep, the bottom being flat rocks on one side and much fine sand and gravel on the other. This bed has also been fished for 15 years for pearls and baroques, and while the shells are exceptionally good for button purposes they have never been utilized. The spectacle-case (*M. monodonta*) was once common here, but has been nearly exterminated by being used for fish bait. Another bed at Lancaster Island shows similar conditions; the button shells are of first quality, but have never been utilized.

At the lower end of Goodall Island in the main river below Carthage there are two small beds separated by a short interval. The current is slow but steady, while the bottom is of firm gravel mixed with yellow clay. There was a pile of about half a ton of shells here. Down nearer to Lock 7 there is a third bed in water from 14 to 16 feet deep, which was fished for pearls up to 1908, two years before the lock was finished. The Ohio River pigtoe is the principal commercial species here, with a good sprinkling of second-grade button shells. The effect on this bed of the dam at the lock seemed to be to kill off the mussels at the lower end, but to allow the upper end to broaden out considerably. The clammer here opened all his shells with a knife instead of steaming them, since he was working principally for pearls.

He was reported to have found three during the preceding week, one of which sold for $100.

At Beasleys Shoals there is a large and important shell bed with several good-sized piles of shells along the banks. These piles aggregated about 10 tons, and the Ohio River pigtoe furnished 80 per cent of the merchantable shells in them. They represented chiefly the residue of a great amount of clamming done here in the past. An Ohio River clammer had taken out 200 tons of good shells and left about 8 tons of culls, of which the elephant-ear formed 90 per cent. The bottom was gravel mixed with yellow clay and covered with 12 to 16 feet of water. Of 5 pigtoes examined 4 were gravid, 2 had young in the outer gills only, while the other 2 had a number of young in the inner gills also. The *Quadrula subrotunda* had orange flesh while part of the gills contained carmine eggs, most of which had been aborted.

Below Cedar Bluffs we found a pile of 12 tons of shells which had been collected a year or more before, and cribbed. The mussel bed here was large with a very slow current over a bottom of gravel covered in some places with clay. The bed has been extensively fished for pearls; during the previous year (1910) 8 boats had been employed and they collected over 100 tons of shells, more than half of which were saved and sold. But there was fully a carload of good button shells scattered along the banks.

Goose Creek, a tributary of the Cumberland from the north, was examined August 10, but although the conditions seemed in every way favorable no mussels could be found.

At Daniels Landing the mussel bed is half a mile long and 150 feet wide in water 12 to 16 feet deep, with a bottom of yellow clay and sand changing to rocks at the lower end. The fishing here has been chiefly commercial since pearls are scarce. Eight men fished this bed in the summer of 1910 and obtained 100 tons of shells, the principal commercial mussel being the Ohio River pigtoe, which is of extra-large size and of the best quality. A few very large niggerheads were also found. In spite of the large amount of shells taken from this bed it still remains one of the richest in the river.

At the mouth of Spring Creek, below Hunters Point, there is a large mussel bed 1 mile long and 125 feet wide, in a very slow current over a bottom of gravel and yellow clay covered in places with mud. This was first fished in 1910, when 50 tons were taken; at the time of our visit in 1911 the clammers had obtained about 14 tons, nearly all of Ohio River pigtoe, with a few washboards and niggerheads. Another large mussel bed was reported at the foot of Wings Eddy Bar, and still another at Armstrongs Island. At Cairo we saw a pile of 12 tons of shells, mostly Ohio River pigtoes.

At Grallatin Landing the mussel bed is $1\frac{1}{2}$ miles long and from 40 to 60 feet wide, on a bottom of gravel and yellow clay covered with mud. The river widens considerably, there is much dead water, and the shores are low, making the conditions almost lake-like. This is all the result of excessive backwater from the lock dam just below. The first *Quadrula fragosa* was found here.

At the head of Lindsleys Island we found a very large number of small shells killed by muskrats; 95 per cent of these shells were pigtoes. There is no commercial fishing here nor even any pearling. We found in this bed our first yellow sand-shell, and also a spectacle-case, specimens of which we had not seen for some time. Farther down the river, at the end of Lindsleys Bar, there was a clammer's camp. About 600 pounds of shells had been collected, of which the pigtoe formed 50 per cent, the washboard 25 per cent, and the remainder mixed species, including a few yellow sand-shells. There was a good mussel bed at Hills Island above Nashville on a muddy bottom in a fairly rapid current. Many mussels had been killed by muskrats who seemed to have a particular liking for small pigtoes.

Stones River, an important tributary from the South, was examined along its East Fork at Walterhill, Tenn. The water was shallow and turbid with numerous riffles; the bottom was composed of loose rocks with intervening gravel bars, covered with plenty of water willow.

Below the ford was found a large number (70) of a beautiful new species of *Truncilla* (see p. 46), many individuals of which had been killed by muskrats. The *Symphynota costata* found here were remarkably large, and contained many lusterless pearls.

The West Fork of this river was visited at Murfreesboro, Tenn. It is somewhat larger than the East Fork and is broken up by divers islands covered with water willows. There were many *Anodonta grandis* and *Symphynota costata* of large size on the bank, recently killed by pearlers.

The mussel fauna here is remarkable in containing several species not found at all in the Cumberland, and in a peculiar interchange of species. *L. ovata* of the Cumberland is replaced here by the genuine *L. ventricosa* and *Q. perplicata* is replaced by *Q. undulata*. The presence of *Q. rubiginosa* is unexpected, and that of the genus *Anodonta* is interesting, since this is the only place in the Cumberland or its tributaries where representatives of this genus were found.

At the foot of Gowers Island, 25 miles below Nashville on the main river, there is one of the most important mussel beds in the entire Cumberland. And we found here the largest pile of mussel shells yet seen, about 80 tons with 8 tons of culls. The bed is 3 miles long and from 60 to 175 feet wide in a strong current on a bottom of gravel mixed with sand and clay. The young pigtoes here were all so

brightly rayed that for a time they were regarded by the clammers as possibly a new species. Harpeth River, a tributary from the south which enters the Cumberland a little way above Lock A, was examined 5 miles above its mouth. The bottom here was of shingly gravel, changing to solid rock and farther up to beds of soft mud. There was formerly a large mussel bed here, but the backwater from the lock dam has killed the mussels in the lower portion of the bed. Another large bed was reported $1\frac{1}{2}$ miles farther up the river.

The unusual size and thickness of the shells obtained here suggest that this river would yield exceptionally good button material. The margins of the shells were much pitted, indicating parasites in unusual abundance. The presence of fine large *L. ventricosa* and *S. costata* so near the mouth of the river is remarkable, since both of these species are absent from the Cumberland.

Below Lock A we saw numerous sites of old shell piles where clamming operations had been carried on in the past. At Half Pone Bar the current was swift, the water shallow and somewhat turbid, and the bottom firm gravel and sand. The large number of specimens and species is at least partly due to the peculiar configuration of the bottom and the low stage of the water, the conditions being similar to those at Salt Lick Island (see p. 29). The great majority of the shells obtained were young, but many of them were eroded at the umbones. *P. donaciformis* was exceptional in being very thin and having a pink nacre. The large number of *Plagiola* is noteworthy, together with the only specimen of *Truncilla florentina* found below Nashville.

At the Seven Mile Ferry above Clarksville the current was rather feeble, the water clear, and from 5 to 8 feet deep, and the bottom composed of fine gravel. From this point on down the river a crowfoot bar was employed, similar to that used by commercial clammers but shorter and smaller, and furnished with 50 hooks. The latter were of two kinds, the ordinary form used by clammers and an improved form invented by Mr. Boepple, having a knob at the tips to prevent small mussels from taking hold or larger ones from dropping off. Hauls were made 200 feet long, the first as near the shore as possible, and each succeeding one 10 feet farther out. The detailed record of the different hauls made at a few stations is given in full, in order to convey a more accurate idea of the number and distribution of the mussels, and the ease or difficulty with which they could be caught. Such a record was kept for all the stations in this portion of the river, and forms an important factor in determining the relative abundance of the mussels.

At Owl Hollow Bar, $2\frac{1}{2}$ miles above Clarksville, we found a swift current with clear water over a clay bottom, more or less mixed with gravel. This bed had been worked for eight years and showed signs

of depletion. The detailed record of the 14 hauls made here is given in the following table:

HAULS MADE AT OWL HOLLOW BAR.

Number of haul	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total.
Duration in minutes	4	4	4	3	3	5	4	3	3	6	4	9	4	6	
Lampsilis ligamentina gibba	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
Obovaria reflexa	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
ellipsis	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Plagiola securis	....	....	....	....	....	....	....	....	....	1	1	....	....	....	2
Unio crassidens	1	3	....	1	....	3	1	1	....	....	....	1	1	....	12
gibbosus	....	....	....	....	....	1	....	....	1	....	....	1	1	....	4
Quadrula heros	2	....	1	....	....	1	....	2	....	....	....	....	....	....	6
obliqua	13	9	14	6	4	7	4	....	2	3	3	16	5	4	90
ebena	2	1	1	1	....	....	3	1	....	2	1	3	1	1	17
tuberculata	....	....	1	....	....	1	....	....	....	....	....	....	1	1	4
cooperiana	....	....	....	....	....	1	....	....	1	....	....	....	....	....	2
fragosa	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
metanevra	....	....	....	....	....	....	....	1	2	5	5	1	1	1	16
pustulosa	....	....	....	....	....	....	....	....	....	1	1	....	....	....	2
Total	18	13	17	8	4	14	10	6	7	12	11	22	10	7	159

This was one of the most important mussel beds visited, since clamming was going on actively at the time of our visit, the shells being used at the Clarksville blank factory. The bed has been worked for 10 years with from three to six boats every summer, but it shows very little sign of depletion. In sorting the shells the washboard (*Q. heros*) is piled by itself, because it is badly stained, and sold at one-half or one-third the regular price. It forms about one-fifth of the entire catch.

Of the first-grade shells the pigtoes are much the most abundant, followed by the niggerhead and the monkey-face. Mussel enemies are scarce, most of the mink and muskrats having been trapped. Pearls and baroques are rare, slugs run about three-quarters of an ounce to the ton. A large number of the pigtoes obtained were gravid and several had young in all four of the gills.

At Clarksville June 12 the river was very low and a large sand bar was being uncovered. The bottom was fine gravel and the water rather shallow, with a slow current. The yellow sand-shells were traveling rapidly into deeper water. *Plagiola donaciformis* was gravid.

At Red Rock Bar, below Clarksville, on June 6 the water was unusually clear, about 8 feet deep, and there was practically no current, the bottom firm gravel. Fourteen hauls were made here under the same conditions as at Owl Hollow Bar, save that each was 300 feet long. The mussels found gravid here were 1 *O. reflexa*, 2 *U. gibbosus*, 3 *Q. perplicata*, 1 *Q. pustulosa*, 77 *Q. obliqua*, and 10 *Q. ebena*. This is the only place in the main Cumberland that we found *S. complanata*. This bed has been worked eight years and begins to show the effects of it. The shells obtained are of better quality than when the work first began, but there are fewer slugs,

the shells being younger. *Quadrula perplicata*, called locally the "round lake," is the pearl bearer here.

HAULS MADE AT RED ROCK BAR.

Number of haul	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total.
Duration in minutes	7	6	2	6	8	2	9	12	5	9	12	14	11	4	
Lampsilis ligamentina gibba												1			1
anodontoides		1					1		1						3
gracilis		1													1
alata								1							1
Obovaria ellipsis								1	1		1				3
reflexa							1		2	1					4
Plagiola securis				1					1	2		2		2	8
Unio crassidens	3	3			1	2		1	3					2	15
gibbosus			1	2			1	2		1		1			8
Symphynota complanata	1	1													2
Quadrula heros	3	1					2		2	1		1	2		12
obliqua	21	2	6	17	20	12	25	12	3	13	8	18	10	20	187
ebena	3	2		1	1		2				1		3	5	18
cooperiana					1			1			1		1		4
fragosa	1			1											2
pustulosa	3														3
perplicata	1	1			1	2	5		2	1					13
Total	36	12	7	22	24	16	37	18	15	19	11	23	16	29	285

Trices Landing is 1½ miles below Clarksville and the conditions are almost exactly the same as at Red Rock bar, except that the bed is full of "hang-ups," and therefore not fished commercially.

At Meeks Spring bar, about 8 miles below Clarksville, some fine springs enter the river, one of which has its outlet richly incrusted with diatomaceous scum. The current was very slow and the water unusually clear over a bottom of coarse gravel. This bed has been fished for 10 years and 500 or 600 tons of shells have been taken from it. Most of the *O. reflexa* and *Q. fragosa* were found cleaned at muskrat holes and were practically the only shells there. The yellow sand-shell and the rabbit's foot had been going shoreward during a previous rise in the river, but turned and went back when the water fell. Many of these sand-shells were gravid June 10 and were used in making a plant of mussels in the river at Clarksville.

The Red River is the only tributary of any size that enters the lower Cumberland from the north. No mussels could be found for several miles above its mouth, probably because the bottom was found to be covered with soft mud which shifted considerably during high water.

At Ringgold, on the west fork of the river, there is a high milldam, which backs the water up for several miles. No mussels were found above this dam, and below it they were rather scarce and all of small species. Several *L. multiradiata* were found which showed no rays, a few *L. vanuxemensis*, and one live *L. glans*. This proved to be the only place where *vanuxemensis* occurred.

Mr. Boepple visited Port Royal, at the junction of the two forks of Red River, on June 14. The river here is not large and is shallow

except a few deep holes; the bottom is gravel and mud. The mussels were collected with a rake and by wading, and were mostly near the bank in the mud, only a few being found in the gravel. Sixteen species were obtained in all, two of which, *S. costata* and *S. complanata,* were rare in the main river. The mussels were said to have been formerly abundant, but they had been nearly cleared out by pearlers, and not enough marketable species were left to make fishing profitable.

Haynes Lake lies several miles below Clarksville, on the north side of the river, and is apparently a part of the old river channel. It is about a mile long and surrounded by woods; the bottom is soft mud and the water is about 3 feet deep, with a temperature of 89°. Very large specimens of *Anodonta grandis gigantea* were obtained, 2 of which contained sporocysts of some distomid, while 2 others were gravid (Sept. 4). The nacre of 8 was purplish, that of the remaining 17 a beautiful creamy white. Of the 2 specimens of *A. imbecillis* 1 was gravid.

Elk Creek Shoals, 13 miles above Dover, had a current of 3 miles an hour in water 10 feet deep over a bottom of gravel mixed with some sand. Nine of the pigtoes obtained here were gravid (May 30), and on the land bar above the shoals was found one dead *Truncilla sulcata,* a species which is exceedingly rare in the Cumberland.

Walter's shelling camp was about a mile below these shoals, and Mr. Walter very kindly conveyed us up and down the river in his launch, giving much valuable information. He had a pile of shells containing about 150 tons, of which the most important button shells, in the order of their abundance, were the Ohio River pigtoe, the Cumberland pigtoe, the monkey-face, the yellow sand-shell, the butterfly, the niggerhead, and the southern mucket.

At Glasgow Landing, 2 miles above Dover, on May 29 the current was about 4 miles an hour, the water high and muddy but rapidly falling, and the bottom gravel mixed with clay. About one-third of the pigtoes were gravid, the glochidia being usually in the lower half of the outer gills. The niggerheads were also in the early stages of gravidity, all four gills being red and padlike; one elephant-ear was gravid. At the foot of Dover Island the conditions are the same as just recorded except that the water was 20 feet in depth. A small species of *Atax,* with broad white marks on the back, was found on several of the mussels obtained here. Marginal distomid cysts were fairly common, especially in *P. securis* (the butterfly). This same butterfly was frequently gravid, the pigtoe was less often gravid, and a single specimen of *Q. fragosa* had glochidia in all four gills.

A noteworthy feature of the lower river, somewhat marked at Clarksville, but decidedly more so at Dover and below, is the land-

slips that occur along the banks, when great masses of earth slide into the water, sometimes carrying trees with them.

At Jones Landing there was another clammers' camp, operated by a Mr. Scarborough, who rendered us considerable assistance. The water here was 15 feet deep and the current about 3 miles an hour over a bottom of mud and gravel. Sixteen hauls were made here, with the following results:

HAULS MADE AT JONES LANDING.

Number of hauls	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16[a]	Total.
Duration in minutes	15	8	6	5	4	2	2	4	8	6	6	8	5	8	4	4	
Lampsilis anodontoides	....	....	....	....	....	....	1	2	....	....	....	....	....	....	....	....	3
gracilis	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
alata	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Plagiola securis	1	1	1	....	1	....	....	....	....	....	....	....	1	2	....	....	7
Unio crassidens	....	1	....	....	2	....	....	....	....	....	....	1	1	....	....	....	5
gibbosus	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Obovaria ellipsis	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
reflexa	....	....	....	....	1	....	....	....	1	1	....	....	....	....	....	....	3
Quadrula heros	2	2	5	1	2	....	....	3	1	3	....	6	....	1	....	....	26
obliqua	13	15	12	12	31	14	....	20	18	24	4	32	21	27	25	....	268
ebena	1	....	1	1	4	....	....	3	....	2	....	4	5	....	2	....	23
tuberculata	1	....	....	....	1	....	....	....	1	....	....	1	1	....	....	....	5
fragosa	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
metanevra	....	....	....	....	....	1	....	....	....	....	....	....	....	1	2	....	4
pustulosa	1	1	....	....	1	....	....	....	2	....	....	1	....	....	2	....	8
perplicata	....	2	....	2	1	1	....	....	....	....	....	1	....	....	....	....	7
plena	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
trigona	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
Total	19	22	19	16	44	18	1	28	23	32	5	46	31	31	31	0	366

[a] No mussels taken.

At Three Sisters Springs, near Linton, Ky., some remarkably large springs flow out of a cave into the river. There was a current of 4 miles an hour in water 20 feet deep over a bottom of soft gravel. No parasites were found except distomid cysts along the margin of the mantle of a few shells. Stained and rough tips, which in some places indicate pearl formation, were common in the shells here. Six of the pigtoes had the lower half of the outer gills filled with glochidia (May 24). All the mussels examined had their intestines filled with greenish mud and appeared well fed.

The main bed is a little below the springs and had been worked for four seasons. Our helper, who had been a professional clammer, had on one occasion dug in this bed 13 boxes of shells of 100 pounds per box in one day. This was in competition with another man who dug 12 boxes in the same time—a ton and a quarter by the two men in a single day.

Below Linton shell beds are common but none were being worked above the mouth of Donelsons Creek. The largest of these beds is at Dead Mans Bar, where there was a large pile of culls near the mouth of Terrapin Creek.

At Donelsons Creek a clammer had just begun working and had only a few shells, chiefly pigtoes, washboards, niggerheads, and

monkey-faces. A mile below Canton, Ky., there is another bed in 12 to 15 feet of water which had been worked previously as was evidenced by an old shell pile, in which a single valve of *L. fallaciosa* was found. In the hauls here taken by our party were obtained, May 23, four gravid niggerheads and five pigtoes.

The bed at Eddyville, Ky., examined May 18, was on a gravel bottom covered with 15 feet of water, with a current of about 2 miles an hour. This bed had been worked more or less for four years, but was difficult and unsatisfactory on account of numerous "hang-ups."

Just above the Ferry at Kuttawa, Ky., there was a large mussel bed on a bottom of sand and gravel, covered with 8 or 10 feet of water, with a swift current. Eighteen hauls were made with the following results:

HAULS AT KUTTAWA, KY.

Number of hauls	1	2	3	4	5	6	7	8	9	10	11 [a]	12 [b]	13 [a]	14 [c]	15	16	17	18	Total.
Duration, minutes	3	3	6	4	4	4	4	3	4	6	5	2	4	5	5	2	5	5	
Length in feet	100	200	100	100	100	30	100	50	50	100	100	30	60	40	100	30	100	100	
Lampsilis fallaciosa			2																2
orbiculata					1					1									2
ovata							1												1
recta										1									1
alata																	1		1
gracilis							1												1
Quadrula heros		6	5	3	6	1		7				1				4		1	34
ebena	1	8	4	3	18			1		26					6		9	12	88
obliqua		2		7	11		8	3		2							7	8	48
fragosa				1						1							1	1	4
metanevra				1	2	1	3	1		2									10
pustulosa				1													1		2
perplicata						1			4								8		13
trigona								1											1
tritogonia							1												1
Unio crassidens			1	4	1		3	1		1							2	3	16
Plagiola securis		1																	1
Total	1	17	12	20	39	3	17	14	4	34	0	1	0	0	6	4	29	25	226

[a] No mussels, due to shifting sand. [b] Water 50 feet deep. [c] No mussels.

Of the gravid mussels obtained in these hauls the elephant-ear (*U. crassidens*) had the entire outer gills padlike, striate, and white. *Lampsilis orbiculata* has a marsupium that is black-edged, while the mantle is striated brown and black like that of *L. ventricosa*. The pigtoes (*Q. obliqua*) were just beginning to become gravid (May 13), with minute white spawn along the crenate edge of the outer gills. In *Lampsilis gracilis* the posterior half of the outer gills had much the appearance of a lima bean, in which the conglutinates were somewhat separated, with no black edge and no furrows.

CHARACTER OF WATER OF THE CUMBERLAND RIVER.

In the coal regions of the upper Cumberland River the water is generally clear and of an acid nature. The acidity is well shown by the limy parts of the dead shells being greatly dissolved away and in

many cases the epidermis alone left. That the mussels do not thrive well in this portion of the river is probably due to the fact that the bottom is rocky, food scanty, and the water deficient in lime.

Below the Cumberland Falls in the limestone formations the water contains a considerable percentage of lime. Here the shells are much larger and thicker than those above the falls.

The table given below is taken from the United States Geological Survey "Water-Supply Paper 236," by R. B. Dole, and shows the mineral conditions of the Cumberland River, at Nashville, Tenn., and Kuttawa, Ky., two widely separated localities of the lower river. A sample of water was taken daily, these mixed, and a sample from the mixture was taken for analysis. There were about 3 analyses made per month, or 36 per year. This method gives a much better general knowledge of the conditions than a single sample would do. From Nashville the samples were collected from October 24, 1906, to November 3, 1907, and 35 analyses made; from Kuttawa, from January 11, 1907, to January 11, 1908, 34 analyses were made.

The following table gives the general average of the analysis, in parts per million, and also the per cent of the anhydrous residue:

MINERAL ANALYSES OF WATER FROM CUMBERLAND RIVER.

[Parts per million, unless otherwise stated.]

	Near Nashville, Tenn.		Near Kuttawa, Ky.	
	Mean.	Anhydrous residue.	Mean.	Anhydrous residue.
		Per cent.		*Per cent.*
Turbidity	126	....	176	....
Suspended matter	94	....	165	....
Coefficient of fineness	.74	....	.92	....
Silica (SiO_2)	20	16.4	18	14.6
Iron (Fe) [a]	.42	1.5	.30	1.4
Calcium (Ca)	26	21.3	28	22.8
Magnesium (Mg)	3.6	2.9	4.3	3.5
Sodium and potassium (Na+K)	9.6	7.8	7.8	6.3
Carbonate radicle (CO_3)	0	37	.9	40.6
Bicarbonate radicle (HCO_3)	92	....	100	....
Sulphate radicle (SO_4)	14	11.4	9.7	7.9
Nitrate radicle (NO_3)	1.2	1.0	1.8	1.5
Chlorine (Cl)	2.1	1.7	3.0	2.4
Total dissolved solids	119	....	124	....

[a] Fe_2O_3.

COMMERCIAL VALUE OF THE MUSSELS.

Taking into consideration both the relative abundance of the species and the intrinsic value of the shell, the southern mucket (*L. ligamentina gibba*) is the most important commercial mussel of the upper river; that is, from Burnside down nearly to Nashville.

From Nashville to Clarksville the mucket is not relatively as abundant, and is consequently surpassed in value by the Ohio River pigtoe (*Q. obliqua*).

From Clarksville to the mouth of the river the honors are divided between the pigtoe and the niggerhead (*Q. ebena*). There are other shells all along the river which possess a high intrinsic value but are not found in sufficient quantities to equal the ones just mentioned. The most important of these are the yellow sand-shell (*L. anodontoides*), the most valuable of all our fresh-water species, the butterfly (*P. securis*), *Lampsilis orbiculata*, a shell of very high value and desirable for propagation, and the Missouri niggerhead (*O. ellipsis*). The Cumberland pigtoe (*Q. cooperiana*) and the long niggerhead (*Q. subrotunda*) are also much esteemed by the button manufacturers. Samples of shells from the upper portions of the river were carefully weighed, measured, and appraised by Mr. Boepple, with the results indicated in the following table:

COMMERCIAL VALUE OF MUSSEL SHELLS TAKEN FROM THE CUMBERLAND RIVER IN OCTOBER AND NOVEMBER, 1910.

Species.	Locality.	Weight.	Number shells.	Number blanks.	Lines.	Number gross per ton.	Value per gross.	Value per ton.
		Pounds.					*Cents.*	
Lampsilis ligamentina gibba.	Martinsburg, Ky	5	16	287		685	5	$34.25
Do	Coes Landing, Ky	2½	12	180	20	916	6	54.96
Do	Martinsburg, Ky	5	17	222	20	522	3	15.66
Do	do	5	17	222	20	723	5	36.15
Do	Burnside to Burksville	5	32	390		928	5	46.40
Do	Obey River, Celina, Tenn.	5	12	57	36	135	20	27.00
				129	20	307	7	21.49
Quadrula obliqua	Coes Landing, Ky	5	37	76	30	180	10	18.00
Dromus dromas	Martinsburg, Ky	2½	11½	23	35	109	15	16.35
Lampsilis ovata[a]	do	2½	11½	T 67		319	2	6.38
Dromus dromas and small Quadrulas mixed.[b]	do	2	34	125		744	2	14.88
Unio crassidens	do	2½	13½	137	20	652		

[a] Tips. [b] Pearly tips.

A good idea of the extent of clamming operations on the river below Nashville may be obtained from the following data, contributed by various shell buyers at Paducah, Ky.: On some of the beds mussel fishing has been conducted for at least 10 years. One mussel firm, with headquarters at Paducah, had 300 boats operating from Paducah to Nashville. In 1907 this company obtained 1,783 tons of shells from this part of the Cumberland River; in 1908, 1,400 tons; in 1909, 1,100 tons; in 1910, 1,125 tons. In consequence of a sudden drop in the price of shells this company was not working the river during 1911.

Another buyer reported 500 tons obtained from the same region of the Cumberland by his company during each of the years 1907, 1908, and 1909, but only 100 tons in 1910.

In addition to these companies there were Ohio River parties and private fishermen operating in the river, which must have increased the annual output to considerably over 2,000 tons per year.

Because of the drop in prices mentioned above, none of the larger companies were operating the river during 1911 with the exception of Mr. Walter, at Dover, Tenn., and the blank factory at Clarksville, Tenn.

BREEDING SEASON OF THE CUMBERLAND MUSSELS.

Throughout the progress of the survey the various species of mussels were examined as to breeding condition and the date at which the various species were found gravid is shown in the table following. In addition to the table, which gives only the bare facts, the following additional notes will prove of interest and value.

The only *Lampsilis ovata* found gravid was on May 13. Mr. Boepple sent in some gravid examples during the late autumn of 1910. Without doubt this species is usually gravid from autumn until the next spring. *L. multiradiata* was found becoming gravid July 28. In other streams we have found it fully gravid in September and October. *Lampsilis anodontoides* was found fully ripe in abundance from June 10 to 21. The breeding season of this species is well known; it usually becomes gravid in autumn and remains so during the winter. *Quadrula perplicata* was noticed becoming gravid May 24, and gravid samples were still found July 27. Although *Quadrula cooperiana* remained gravid for a considerable length of time, we saw only a few samples; the citations refer to single individuals, so that, while we have it recorded from June 3 to August 11, only 11 gravid examples altogether were seen. The characteristics of the gravid mussel are described under the discussion of the species. It is a desirable species to propagate. *Quadrula obliqua* is the most prolific mussel in the river, and we saw many more gravid examples of this than of any other species. From June 3 to 10 is the height of its breeding season, and at that time about half the catch obtained would be gravid. When the life history of the species is known and the fish which serves as host, it will be easy to procure material for propagation during a considerable part of the summer.

Quadrula ebena was observed in early stages of gravidity about the beginning of the work, and gravid examples were obtained as late as July 16. The other species noted are not of special economic importance and gravid examples were found only in small numbers. Sufficient information about them can be obtained by a glance at the table.

TABLE OF GRAVID SPECIMENS OF MUSSELS FOUND IN THE CUMBERLAND, 1911.

Dates.	L. ovata.	L. multiradiata.	L. anodontoides.	L. vanuxemensis.	L. gracilis.	M. conradicus.	O. circulus.	O. ellipsis.	O. reflexa.	A. imbecillis.	A. grandis.	U. gibbosus.	U. crassidens.	P. clava.	Q. perplicata.	Q. cylindrica.	Q. metanevra.	Q. pustulosa.	Q. fragosa.	Q. cooperiana.	Q. obliqua.	Q. coccinea.	Q. subrotunda.	Q. ebena.	Q. tuberculata.
May 13	×	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...
17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
24	...	...	...	...	...	...	...	...	×	...	...	...	...	...	×	...	...	...	...	...	×	...	...	×	...
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...
June 3	...	...	...	...	...	...	...	...	×	...	...	...	×	...	×	...	×	...	...	×	×	...	...	×	×
5	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	×	...	...	×	×	...	...	×	...
6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...
7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
10	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
16	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...
21	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
July 1	...	...	...	...	...	×	...	...	...	...	...	×	...	×	×	...	...	...	...	...	...	...	...	...	...
8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...
9	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	×	×	×	...	...	...
10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	×	...	...	...	...
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	×	...
13	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	×	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	×	...
15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...
16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...
27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	×	...	...	×	...
28	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aug. 9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	×	...	...
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...
17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
21	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
Sept. 2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...

PEARLS AND PEARLING IN THE CUMBERLAND.

Just when pearling began on the Cumberland there is no definite record. It has been in operation quite steadily on the upper river for at least 20 years. It is not generally carried on actively the year round, but chiefly in August and September, when the water is low. There are few professional pearlers, however; that is, men who devote their entire time to the gathering of pearls. Most of the pearling is carried on by farmers at odd times, and by men who in the winter devote their energies to lumbering, chopping, or trapping.

Hunting for pearls is confined mostly to the upper river and the tributaries. It seems that the conditions suitable for pearl formation are more abundantly fulfilled in small streams.

The first sign of active pearling operations seen by the present survey was encountered about Burnside. The search for pearls extended above the town as far as Seven Mile Shoals and downstream as far as Celina, and less actively to Carthage and beyond. A short

distance below Burnside pearling has been recently in active operation, at Pittman and Fishing Creek. From Burnside down to Burkesville Mr. Boepple had noted in 1910 that the river bed was well filled with shells killed by pearlers, and in 1911 the same work was being continued farther on downstream. At Patty Shoals below Mill Springs in 1910 "yellow mussels" (*L. ligamentina gibba*) had been pretty well fished out, since the pearlers opened only this species.

In order that due allowance may be made for the inevitable degree of unfounded rumor on such subjects, we will give at first the reports of the rivermen and supplement them later by our own observations.

At Burnside we heard that a pearl had been found at the mouth of Pittman Creek which was worth $250 or $300 and another that had been sold for $40, and we were told of a man living down the river, back some distance in the country, who had a fad for pearling and buying pearls, and who had accumulated in this way about $20,000 worth of pearls, baroques, and slugs at the time our informant visited him. Many pearls had been found in the vicinity of Eadsville, the highest price any single pearl from that locality brought being $800.

In August and September 100 men were often pearling at once on a shoal near Rowena, and the highest price paid for any single pearl was $500. There had also been much pearling on a mussel bed below Tear-coat Bar and on another at Clouds Island during the past five years, sometimes as many as 50 men working at the same time. At Goodall Island, for 20 years previous to the time of closing the lock, pearling had been in active operation. At one time 150 men were at work together on the bed, and in one week $30,000 worth of pearls were found. Pearling had also been carried on near the mouth of Goose Creek above Hartsville in former years, but it stopped after the building of the lock below, which flooded the beds with lock water and rendered it difficult to obtain the mussels.

Not only the upper river but its tributaries also were famous for pearls. At Carthage it was said that better pearls were found in the Caney Fork than in the Cumberland, and that they commanded a much better price. Mr. Boepple, who investigated the lower 26 miles of the Obey River at Celina, remarks: "Twelve to fifteen years ago there was much pearl fishing here, and it seems to have paid until, indeed, the mussels had been fished out by pearlers." Stones River was in good repute as a pearling stream, and a merchant at Clarksville stated that his father used to buy many pearls from there. There had been active pearling on this river only a short time before our visit, and some shells left by the pearlers and examined by our party showed indications of pearl formation. Red River, which enters at Clarksville, is said to be a good pearl-bearing stream in its upper

portion, and we saw a number of very good pearls from there. Little River, across from Canton, Ky., is also said to yield numerous pearls, which, however, are rather small.

Our own observations, as well as the records of people engaged in the pearl trade, indicate that pearling was once an important occupation in the upper river. We saw in many places large piles of shells left by pearlers along the river banks, and came across one party actively engaged in pearling. Mr. Boepple saw a collection of pearls in Rowena valued at $1,000, and this represented only a portion of those found in the vicinity, since the largest and finest pearls were sent directly to New York. At Butlers Landing a storekeeper showed us a very pretty collection of "rosebud" pearls, all with a good luster, four of which were purple, five yellowish, and eight white.

At Clarksville, as mentioned above, we saw some very pretty pearls from Red River. One of the principal merchants at Carthage buys about $15,000 worth of pearls every year. The highest price he had paid for a single pearl was $2,500. They generally range from $20 to $300. A shell buyer at Paducah, Ky., bought $2,000 worth of pearls during the season of 1910. While genuine round pearls are not common in the lower river, rough pearls and baroques are usually present to the amount of three-fourths ounce per ton of shells. The baroques vary from $2.50 to $3.50 an ounce.

On account of the ground to be covered and the time at our disposal, together with unfavorable weather while on the upper Cumberland, we did not have opportunity to devote very much attention here to pearl formation, though this region would prove an exceptionally good location from which to attack the problem. In looking over the flesh of some mussels recently killed by pearlers a number of black distomid cysts, similar to those found in the Maumee River (Indiana and Ohio), were observed, and these probably figured in part at least as an exciting cause.

A study leading to the discovery and the consequent conservation of the peculiar conditions which favor pearl formation in the upper Cumberland and its tributaries, accompanied with active propagation of the southern mucket in that region, would be highly desirable. The mussels are not yet so nearly exterminated that gravid material can not be readily procured, though it is feared that they soon will be, in view of the active depredations of the pearlers. It is believed that mussel planting could be kept well ahead of any onslaught likely to occur and that the resulting harvest would yield not only an abundance of the very best button material but also a plentitude of pearls, and thus prove a source of much greater benefit than where mussels are reared for the shells alone.

DISCUSSION OF MUSSEL SPECIES.

In the list of species here presented we have followed in most respects the classification and sequence given in Simpson's well-known Synopsis of the Naiades. In the spelling of the names, however, we have followed the suggestions of Lindahl [a] and have made also a few minor changes, such as the substitution of the older name *Quadrula undata* for *Quadrula trigona,* as suggested by Mr. Bryant Walker, and the transference of the *Medionidus subtentus* (Say) to the genus *Ptychobranchus,* and of *Tritogonia tuberculata* (Barnes) to *Quadrula* under the name *Quadrula tritogonia,* as suggested by Dr. Ortmann. Many other changes have been proposed which will probably in the end prove justifiable. We have avoided making any shifts between *Pleurobema* and *Quadrula,* although several have been advocated which may be desirable. The fact that both *Pleurobema æsopus, Quadrula obliqua,* and another perplexing form which we have found may have glochidia in two, three, or all four gills indicates that these two genera should really be united.

We are very favorably inclined toward the new classification proposed by Ortmann,[b] but its present state of incompleteness and the uncertain position of many species, as well as our own conclusions regarding *Quadrula* and *Pleurobema,* make it seem best at present to use the older and better known system with the few exceptions noted above.

1. *Truncilla triquetra* Rafinesque. Snuffbox.

This attractive little shell occurs only in the upper part of the river. In all we procured 21 specimens, 19 of which were obtained at Salt Lick Bar. In the autumn of 1910 Mr. Boepple found it at Indian Creek, Cloyds Landing, Albany Landing, and in the Obey River at Celina, Tenn.

It is in all probability considerably more common and widely distributed in the river than our collections would indicate. But it does not seem to occur as far down the river as Half Pone Bar or at Clarksville; if it did a few examples would certainly have been taken among the great number of small mussels collected in that region in June.

Truncilla triquetra is a small species, dwelling in the shallower water. On account of its small size it is rarely or never taken on the mussel dredge or rake, but must be gathered by hand. It has a handsome, strong and thick shell, but is too small to have any commercial value. All our examples are pretty well eroded at the umbones.

2. *Truncilla brevidens* (Lea).

This species was not found in the main river at all and only at three stations altogether. It was most abundant in the Big South Fork opposite Parkers Lake Station. Three examples were procured in the same fork 2 miles above Burnside and one in Beaver Creek. It is too small to have any commercial value.

All the specimens found were dead, but some had been recently killed by muskrats, therefore nothing was learned concerning its habits. It appears to be a species

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[a] Lindahl, J.: Orthography of names of the Naiades, The Journal of the Cincinnati Society of Natural History, vol. XX, no. 5, art. VIII.

[b] A monograph of the Najades of Pennsylvania, reprinted from the Memoirs of the Carnegie Museum, vol. 14, no 6, Feb. 15, 1911.

occurring in moderate-sized, clear streams with a rocky bottom, avoiding the smaller tributaries.

3. *Truncilla arcæformis* (Lea).

Rare; only one example obtained. This was procured in the Big South Fork 2 miles above Burnside, Ky., and is rather peculiar in shape.

4. *Truncilla sulcata* (Lea). Pewee, cat's-claw.

Although this species seems to be pretty well distributed along a considerable stretch of the river, we obtained only occasional examples here and there along shore. Mr. Boepple found one in Caney Fork. It can probably be procured in larger numbers during low water. It is common enough to be pretty well known to the clammers, who call it "pewee" on account of its small size, or "cat's-claw" because of the peculiar clawlike structures on the marsupial expansion of the shell of the female.

5. *Truncilla haysiana* Lea.

Our collection of this species is rather small, but it is probably more common than the collection would indicate, as it is too small to bite on the crowfoot hook and is easily overlooked. Most of the examples collected had been killed and cleaned by muskrats. It is one of the handsomest of the *Truncillas* on account of its beautifully polished epidermis, and it has an unusually thick and solid shell for the genus. It is, however, too small for manufacturing purposes.

6. *Truncilla capsæformis* (Lea).

Fairly abundant in the Big South Fork, where nearly all the specimens had been killed by muskrats; in the main river we found it sparingly. Our shells are pretty badly eroded, very thin and brittle, with the marsupial expansion colored a dark green. The species is of no value for manufacturing purposes, being too small and thin.

7. *Truncilla florentina* (Lea).

Rare; the only specimen obtained was the dead shell of an old and very inflated female at Half Pone bar. In the autumn of 1910 Mr. Boepple found a specimen at Indian Creek bar. During low water probably many more could be obtained.

8. *Truncilla walkeri*, new species. (See fig. 1, frontispiece.)

A fine, large *Truncilla* with a honey-yellow epidermis and numerous capillary rays. Shell rather thin, elliptical in outline, much inflated in the females, only moderately in the males. Anterior margin projecting and evenly rounded, ventral margin strongly convex in the larger males, much less so in the females and smaller males; posterior margin oblique, but usually well rounded in both sexes; dorsal margin comparatively long, straight, or slightly curved. Umbones narrow and flattened. Anterior, lateral, and posterior slopes all well rounded; umboidal ridge flattened and indistinct, especially in the females. In front of this ridge the males have a broad and shallow sulcus; in the females the marsupial expansion is very pronounced, and is usually limited anteriorly and posteriorly by a deep and narrow sulcus. It is somewhat like that of *capsæformis*, but is considerably swollen, especially in the larger females, instead of being flattened, and does not project as strongly. Lines of growth smooth, distinct, and close together. Ligament long, thin, and light brown.

Interior: Pseudo cardinals large and thick, rather blunt and only slightly serrate or smooth; laterals long, high, thick, and slightly curved; anterior adductor scar slightly longer than wide, squarely truncated posteriorly; posterior scar large, deeply impressed, and squarely truncated anteriorly much as in *brevidens;* pallial impression fairly distinct, nacre milky white, thinner and quite iridescent posteriorly.

This species was quite abundant just below the ford of the East Fork of Stones River near Walterville, Tenn. We found here 140 shells, most of them on shore and recently killed by muskrats, and 1 or 2 living mussels. The smallest specimen (male)

measures 23.2 mm. long, 15.3 mm. high, and 8.8 mm. in diameter, the smallest female 31 mm. long, 19.9 mm. high, and 12.9 mm. in diameter. The largest male measures 57.7 mm. long, 42.7 mm. high, and 26.4 mm. in diameter, and the largest female 52.8 mm. long, 39 mm. high, and 23.9 mm. in diameter. There are 49 females, the others being males.

Walkeri, to Mr. Bryant Walker, one of our most eminent conchologists.

9. *Lampsilis ventricosa* (Barnes). Pocketbook.

Typical specimens of this species were obtained in two tributaries of the Cumberland, Harpeth River near its mouth, and Stones River, in the east fork at Walterhill and the west fork at Murfreesboro, Tenn. Just how common or widely distributed it is in the streams above mentioned is not known. The examples found were exceptionally fine and would make very good button shells.

In the main Cumberland *L. ventricosa* seems to be quite rare, its place being usually taken by the closely related *L. ovata*. Indeed, the distribution and relationships of *ovata* and *ventricosa* as found in the Cumberland and its tributaries are exceedingly perplexing. A few examples found near Clarksville, and a dwarf shell found at Elk Creek shoals above Dover, however, offered exceptional difficulties in classification, fitting in neither with *ventricosa* nor *ovata;* the male shell would perhaps fall on the *ovata* side of the dividing line; the females on the *ventricosa* side, if indeed not rather beyond the limits of the typical shell; these shells, both male and female, were rather too thick and solid for *ovata*. A marked feature of those at hand is a deep pink tinge of the nacre posteriorly, this tinge being pretty sharply limited to the posterio-dorsal area, a feature not common with either *ventricosa* or *ovata*.

The female shells are considerably more inflated than the males and have a peculiar flattening of the lower part of the posterior margin. One of the female shells was sent to Mr. Bryant Walker, who remarks concerning it as follows: "No. 5456 is a most remarkable shell. I have never seen a female *ovata* with such an enormous expansion. *Ventricosa* not uncommonly tends that way, but not to such an extent. * * * This shell is comparable only with *satur*. [A variety of *ventricosa*, according to Simpson; *satur* is *L. excavata*, according to Frierson.] This shell is either an extraordinary abnormality of *ovata* or is *ventricosa*. In view of the occurrence of *ventricosa* both in the Harpeth and Stones, I am inclined to refer it to the latter."

10. *Lampsilis ovata* (Say). Southern pocketbook; "grandma."

A fairly common species throughout the entire length of the Cumberland, more numerous in the upper portions and upper tributaries.

This species is one of the very few found in the Cumberland above the falls. Mr. Boepple obtained it at Pineville and Williamsburg and we found a few in the vicinity of the latter place and several examples just above the falls. Just below the falls it was abundant and common at the stations farther down. Associated with the typical form, which is relatively uncommon, is an aberrant form, more closely resembling *ventricosa*.

The specimens of this aberrant form were at first identified as *L. subovatus* Say, described and figured by Call.[a] On examination of the literature, however, there is no "*Unio subovatus* Say," and the name in Call's report is plainly a misprint for *ovatus*, the *Unio subovatus* Lea being an entirely different thing.

Say's original description of "*Unio ovatus*" is brief and the figure poor, but recognizable; it is probably better known from Conrad's description and excellent figure.[b]

The greater number of our specimens, however, differ considerably from the typical form. Beginning with the shapely, high-ridged clear yellow shell, which represents

[a] Mollusca of Indiana, Twenty-fourth Annual Report of Geology and Natural Resources of Indiana, p. 481, pl. 39.

[b] Conrad, Monography, p. 4, pl. 2.

the species in its perfection, we have stained horn-colored examples, then deep-brown specimens and specimens with broad distinct rays. Inflated females are likely to have the ridge characteristic of *ovata* less markedly developed than males; in both sexes, however, there is a tendency for it to appear in all degrees of imperfect development until in some examples it is barely discernible. Indeed in one of our examples it is almost wholly absent, and we have a shell that, with the exception of purely individual features, can not be distinguished from a specimen of *L. ventricosa* from the upper Mississippi River.

Judging from the soft parts of a single gravid female examined, the bodies of *ventricosa* and *ovata* are quite unlike, the mantle flap of *ovata* showing a peculiar mottling quite different from the markings observed in the other species.

The variously modified forms of *ovata* are not only more abundant, but also more widely distributed than the type form. Just below Cumberland Falls most of the shells of this species are of medium size or smaller, nearly all are smoky brown, and several are well-rayed. At Indian Creek Bar brown and few-rayed individuals occur along with the typical form. At Goodall Island we found one with numerous distinct rays.

The shells of the Rock Castle River are different from the others and can be told almost at a glance. They are dark brown, longer and heavier than those of the other streams and have the posterior ridge rather low; *ovata* takes nearly the same place in the Cumberland that *ventricosa* does in the upper Mississippi.

We have always found *ovata* considerably inferior to *ventricosa* as a button shell, being thinner, smaller, and more brittle. The Rock Castle River *ovata* could possibly be used for buttons, but would furnish rather poor material. In the Cumberland the *ovata* is a rather valueless shell.

Call's experience with *ovata* is different. He says it is "one of the largest that are found in American waters; * * * it also attains a much greater size than Barnes's form (*ventricosa*)." This may be perfectly true for some rivers, as shells vary greatly in size and thickness in different streams.

11. *Lampsilis multiradiata* (Lea).

Rather rare in the main river and found almost entirely in its upper portion. Occurs typically in small, clear streams and often in lakes. It is more common in the tributaries than in the main river. The specimens from both forks of Stones River are beautiful shells, typical in form, not much eroded, and with a clear, white nacre. The specimens from Rock Castle River, Big South Fork, and the main stream depart more or less from the typical form, being unusually elongate and sharp-pointed posteriorly, rather thin, considerably eroded, and more or less stained or diseased in the nacre or in the teeth. On comparing the Red and Stones River shells with the others, a marked difference was noted in the cardinal teeth. In these typical specimens the large posterior cusp of the right valve pointed more or less anteriorly, while in the Rock Castle River specimens and most of the others it pointed more or less posteriorly. A few shells with intermediate characters in this respect were found, however.

12. *Lampsilis ligamentina* (Lamarck). Mucket.

This species is represented in the Cumberland chiefly by the southern mucket, *Lampsilis ligamentina gibba* Simpson, which differs from the typical form in being shorter and more compressed. The two forms grade into each other so imperceptibly that it is impossible to find the point of separation between them. In the lower part of the river it approaches more nearly the typical form.

The shell of the subspecies often has the epidermis more highly polished than in the type form, the nacre has more luster, and the valves are flatter and more uniform in thickness. The shells are therefore superior to those of the common mucket for manufacturing purposes and are sought after by shell buyers. Like the other forms of this genus this mucket carries its young in the gills through the winter. The

glochidia fasten readily to our common spiny-rayed fishes. Some gravid examples of this form were collected by Mr. Boepple in the autumn of 1910 from the upper Cumberland and sent to the biological station at Fairport, and though the mussels were dead the glochidia were still alive and attached themselves readily to fishes.

This is the most desirable form with which to stock the river and extensive plantings from the falls to the mouth would greatly increase its value as a mussel stream.

13. *Lampsilis orbiculata* (Hildreth).

Fairly common in the middle portion of the river, usually from 1 to 3 examples being found on each bed.

We were struck with the remarkable similarity between this species and the southern mucket, *Lampsilis ligamentina gibba.* About the only way to distinguish between them was by the bright orange shade of the epidermis, and usually orange tint of the nacre of *orbiculata*, and it is easy to understand Call's[a] remark that Dr. Hildreth and the earlier naturalists seem to have considered this shell as a variety of *Unio crassus* Say (= *Unio ligamentinus* Lamarck, short and thick variety found in the Ohio), but Call adds: "It certainly would seem to be a good species." Our own studies and comparisons showed them more distinct than appeared at first glance. The difference is most plainly seen in the female shells, which differ considerably from the males, being truncate posteriorly and short and well swollen postbasally. They are well represented by Say's[b] figure of *Unio abruptus*, and look somewhat like a compromise between the southern mucket and *L. ventricosa.* Ortmann[c] says that this species "is not at all related to *L. ligamentina* as Simpson thinks; but it belongs to the *ventricosa* group of *Lampsilis*, for it has a well-developed flap on the mantle edge."

L. orbiculata also very closely resembles *L. higginsii* which is more generally northern in its distribution, but the males of *higginsii* are shorter, more closely approaching *Obovaria ellipsis. Orbiculata* and *higginsii* are probably closely related.

This is a very good button species, but so uncommon that it is not much of an item in the trade.

14. *Lampsilis tæniata* (Conrad).

Rare; none at all were found in the Cumberland or in any of the tributaries except Stones River. It appears to be a species of small clear streams, and was found in the fine gravel at the edge of the water among the water-willows.

15. *Lampsilis picta* (Lea). Painted mussel.

Rather rare, and not taken by us in the main river. We found three in the Rock Castle River a few miles back from the Cumberland. Mr. Boepple, in the autumn of 1910, obtained it in the Big South Fork at Sloans Shoals, near Burnside. It is too small and thin to have any commercial value. Our largest example measures 61 mm. long, 33 mm. high, and 17.5 mm. in diameter.

16. *Lampsilis punctata* (Lea). Spotted mussel.

It is very like *L. picta* in color and outline, but differs in being more inflated and in carrying its thickness to the edge, so that its ventral margin is rather rounded and blunt, while that of *picta* is sharp. Both species are new to our collection. Mr. Bryant Walker, who identified them for us, called attention to the differences. The shell is thick anteriorly, but thins out rapidly behind the center. It has no commercial value on account of its small size, and most of our specimens are also badly eroded.

17. *Lampsilis perdix* (Lea).

Abundant in the Cumberland just below the falls. Mr. Boepple in 1910 found it as far down as Rowena and in the Obey River at Celina. It is common in Rock Castle and frequent in the Big South Fork.

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[a] Mollusca of Indiana, Indiana Geological Report, p. 493.
[b] American Conchology, pl. 17.
[c] Nautilus, vol. XXIII, no. 9, p. 119.

This species bears a general resemblance to an elongate flattish *L. ligamentina*. Unstained shells are easily recognized by the character of the rays, which are broken up and more strongly marked in places, making a series of heavy green blotches. Another peculiarity is the short lateral teeth, 1 in the right valve and 2 in the left; these are low and blunt, and separated from the cardinals by a wide interspace. Our older shells are badly eroded and so stained and discolored that the characteristic rays and blotches are absent. Such specimens can be recognized by the narrow border of latest formed nacre, which is yellowish or reddish and semitranslucent. Our shells usually have the nacre badly stained. Even if obtained free from stains they would make rather poor button shells, as they are somewhat brittle. In thickness they are about equal to a thin mucket. A few of the examples have brick-red pimply patches on the interior which probably indicate the presence of parasitic trematodes. No parasites, however, were noted.

18. *Lampsilis anodontoides* (Lea). Yellow sand-shell.

Rather uncommon, distributed chiefly through the central portion of the river, and never forming a large percentage of any of the beds. This species thrives best on sand bars in rather shallow water. It is generally confined to large streams. It is one of the most active of the mussels, responding quickly to changes in environment by moving about. This is by far the most valuable of the fresh-water mussels, the shells being generally used for export and in the manufacture of knife handles.

This species is easily propagated, the glochidia fastening readily to most of the common spiny-rayed fishes, such as sunfishes, bass, etc. On June 13 we found a number of gravid shells at Meeks Bar. Some sunfishes were caught, a tub was procured, and an infection made. The infected fishes were then liberated into the Cumberland in front of the blank factory at Clarksville.

19. *Lampsilis fallaciosa* (Smith). Slough sand-shell.

Rare in the Cumberland and not found in any of the tributaries. This species thrives best along shore in shallow water with a rather lively current and muddy bottom. Such conditions exist only in the very lowest portion of the Cumberland. From Kuttawa to the Ohio side sloughs are more common and the species is probably more abundant. The nacre of most specimens secured is stained. This is a first-class species for the manufacture of buttons, but it would be unprofitable to plant in the Cumberland because of the absence of favorable locations for its best development.

20. *Lampsilis recta* (Lamarck). Black sand-shell.

Rather common throughout the entire length of the river, but nowhere abundant. Many of the shells are badly eroded and stained; none are deep pink throughout, but are pale pink about the cardinal teeth and in the umbonal cavity.

Good white-nacred shells of this species are exceptionally excellent button shells, and where select stock could be obtained would be one of the most desirable species to propagate.

21. *Lampsilis lienosa* (Conrad).

The specimens we have are hardly typical and were with some doubt identified as this species. It is a small species of no commercial importance.

22. *Lampsilis vanuxamensis* (Lea).

The females of this species were gravid June 6. They are peculiar in having the marsupial expansion of the shell rather limited in area, not extending to the posterior end, but followed by a pointed extremity. In this localization of the shell they remind one somewhat of the *Truncillas*. The shells are small, red nacred, and of no value.

23. *Lampsilis trabalis* (Conrad).

Found only in the upper part of the river and its tributaries. The females are not markedly swollen posteriorly, but differ from the males in being shorter and broader.

Nearly all we found were dead shells, usually badly eroded at the umbones. Mr. Boepple found the species as far down as Cloyds Landing and in the Obey River at Celina. As found, the epidermis is generally jet black, usually due to the shells being stained. On being cleaned with acids they exhibit beautiful rays. This is a small species of no commercial importance.

24. *Lampsilis parva* (Barnes).

Rare; none at all in the Cumberland; indeed it has not been reported from that river. But we obtained one specimen in the East Fork of Stones River at Waterville. This was a slender shell; length 27 mm., height 15 mm., width 11 mm. Nacre beautifully white and iridescent.

25. *Lampsilis glans* (Lea).

Rare; none at all in the Cumberland; 10 specimens from the tributaries. Those found were in gravel in shallow and rather swift water. In general it prefers quiet streams with muddy banks and burrows in the firm mud. It is also frequently found in lakes.

One of the smallest of our species; too small for commercial use, and with a rich purple nacre. In one specimen, a female found in Roaring River, the peculiar glands of the mantle, small white cylindrical objects on each side, were protruded and were undergoing spasmodic movements.

26. *Lampsilis alata* (Say). Pancake; pink hatchet-back.

While not a rare species in the Cumberland, this is not especially common. In a few of the beds it is entirely absent, and in many only one or two shells were found. It never exceeded 4 per cent of the catch of any of the beds, and is usually less than one. It is well distributed throughout the entire river. It prefers rather deep water and a soft, muddy bottom. The shell, on account of its thinness and red nacre, is of no value whatever.

27. *Lampsilis gracilis* (Barnes). Paper-shell.

Frequent enough to be a rather familiar species among clammers, but not so abundant as to be a nuisance. It has much the same distribution as *alata*, but is less common. We usually obtained only 1 or 2 from a bed. Our shells are rather badly worn at the umbones. As this thin-shelled species is of no value whatever, but readily catches the mussel hooks, it proves to be a nuisance when present in large numbers where clamming operations are being carried on.

28. *Lampsilis lævissima* (Lea). Paper-shell.

Rare; only one specimen found in the Cumberland; this was at Meeks Spring Bar. It seemed to be more common in the Harpeth. This species closely resembles *L. gracilis* in general appearance, but has, among other distinguishing features, a beautifully polished epidermis. Our examples have a number of peculiar rays, consisting not of a different pigmentation of the epidermis but of a series of short, finely wrinkled lines.

29. *Lampsilis leptodon* Rafinesque.

This fragile, thin-shelled species is rare in the Cumberland. The only examples obtained were collected by Mr. Boepple at Albany and Cloyds Landing in the autumn of 1910.

30. *Medionidus conradicus* (Lea).

This species is confined chiefly to small streams. It is exceedingly abundant in the Rock Castle River at Livingston, Ky., the sandy bottom being almost covered with these animals, which showed up as narrow black lines, the mantle and exhalent and inhalent apertures being thin and black. It is also abundant in Roaring River.

In the Cumberland we found it just below the falls and at Salt Lick Island. All the shells were badly stained and eroded, and for this reason, as well as on account of its small size, it has no commercial value.

31. *Obovaria retusa* (Lamarck). Golf-stick.

Although we obtained only a few specimens of this species, scattered valves were frequently found along shore, and there is reason to believe that it is considerably more common than our small collection would indicate, although by no means abundant anywhere. In the Cumberland it attains a rather large size, our largest shell measuring 68.5 mm. long, 74.5 mm. high, and 46.9 mm. in diameter. It is a heavy and solid shell, but the deep purple of that portion of the nacre within the pallial line makes it valueless for buttons. All our shells are somewhat eroded at the umbones. Two of them are considerably less retuse than the others, somewhat approaching *O. circulus* in this respect. All have the epidermis somewhat paler posteriorly, but not so markedly so as is usually the case with *O. circulus*.

32. *Obovaria circulus* (Lea).

Rather common in the main river from Burnside to Half Pone Bar. This species produces too small a shell to be of much importance to the button trade. The larger shells would furnish two or four blanks apiece, and are excellent both as to material and thickness. The nacre seems to be unusually durable and retains its firmness and luster long after others have become chalky.

33. *Obovaria ellipsis* (Lea). Missouri niggerhead.

This species is chiefly northern in its distribution and does not attain large size in the Cumberland. Although in its shell characters it bears considerable resemblance to some of the Quadrulas, especially the niggerhead, *Q. ebena*, it is really more closely related to the sand-shells. Where it attains large size it is an excellent button shell and would be a fine species to propagate, but the reduced size of the shell in the Cumberland indicates that the conditions there are not favorable. We found gravid examples above Clarksville early in June.

34. *Plagiola securis* (Lea). Butterfly.

This species is fairly common throughout the entire length of the river below the falls, and, while not abundant enough to make a large percentage of the shells taken for commercial purposes, it makes a fair sprinkling in most of the clammers' piles. It seems to thrive exceptionally well in the Cumberland and is more common here than in most rivers. The shell, especially of young to medium-sized, well preserved males, is one of the most attractive among the Unionidæ. In the Cumberland there is a marked difference between the shells of the males and females, that of the former being flat and compressed and of rather uniform thickness, while those of the females are much more tumid and swollen. The measurements of a fairly typical male (F5086) of medium size are 54 mm. long, 44 mm. high, and 21.1 mm. in diameter, while those of a tumid female of about the same length (F2660) are 55.3 mm. long, 45 mm. high, and 33.7 mm. in diameter. In the lower part of the river the nacre is somewhat spotted, but upstream the shells are free from stain. On account of its excellent luster, flatness, and uniform thickness, this is an excellent button shell, the males being much superior to the females.

Females were found gravid May 29, and were in the height of the breeding season from about June 3 to 16. This would be a very valuable species with which to stock the river.

35. *Plagiola elegans* (Lea). Deer-toe.

This species is not as common nor as widely distributed as the preceding. Large shells can be used in the manufacture of buttons, but the great majority are too small. The largest example found was a single valve 59 mm. long, picked up at the foot of Gowers Island. The beautifully tesselated green markings on the epidermis make it an attractive shell when perfect.

36. *Plagiola donaciformis* (Lea).

This dainty little species is more limited in its distribution in the Cumberland than either of its two relatives. A peculiarity of the species at Half Pone Bar was the frequent unfolding of the anterior ventral portion of the shell, the inner layer being folded back against the rest, as if by some injury. The specimens found here were unusually thin-shelled and frequently had the nacre well tinged with pink. Perfect specimens of this shell are among the most attractive to be found in the Unionidæ, but the Cumberland examples, especially those from Half Pone Bar, are badly worn at the umbones, so that even small specimens have the appearance of age. This is one of the smallest of the mussels—too small to be of any use for manufacturing purposes.

37. *Cyprogenia irrorata* (Lea).

This species is of rather infrequent occurrence in the Cumberland. We found none at all in any of the tributaries, and usually found only one or two on each bed examined. The species seems to inhabit rather deep water, since we never saw any crawling around on the shallow bars. Most of the examples are rather small, and some have a shallow sulcus running over the middle of the disk from the umbonal region to the postventral margin.

A very solid shell, but of little commercial value, as it is rather brittle and has pink tips. The few shells that get into the clammers' piles are generally worked up, however.

38. *Obliquaria reflexa* (Rafinesque). Three-horned warty-back.

One of the most common shells of the river, and found throughout its entire extent. Although a rather small shell, this is so thick and solid that it is used to a considerable extent in the manufacture of buttons, each valve furnishing one or two small blanks. The species has a long breeding season, spawning through almost the entire summer, the young being extruded in white cylindrical masses. Some of these spawn masses were seen lying on the gravel at Half Pone Bar June 16. Shells of females are somewhat fuller anteriorly than the males and can usually be distinguished after some practice. The Cumberland specimens are not so beautifully rayed as those from the upper Mississippi.

39. *Ptychobranchus phaseolus* Hildreth. Kidney-shell.

Scattered in the upper Cumberland from the falls down to Half Pone Bar. Although this is a species of rather wide distribution, especially southward, and is by no means a rare shell, it is never found in great numbers or making a large per cent in any bed. The clammer rarely gets over a half dozen or dozen to the ton; the nacre is white, with a soft satiny luster; the shape is nearly that of *Unio gibbosus*, and the species would probably make a fair button shell.

40. *Ptychobranchus subtentus* (Say). Fluted kidney-shell.

This species in Simpson's Synopsis is placed in the genus *Medionidus*. Dr. Ortmann, however, has removed it to *Ptychobranchus*, and, although we have seen no gravid examples, we are inclined to follow him in this regard on account of the close resemblance of the shell to that of *P. phaseolus*, differing from that species chiefly in its thinner shell, greater inflation, and the presence of costæ on its posterior slope. On account of its small size and its thinness it has no commercial value.

41. *Dromus dromas* (Lea). Dromedary mussel.

In the main river this shell is of occasional occurrence from Mill Springs Bar, in the upper river, down to Red Rock Bar, below Clarksville, Tenn. We usually obtained one or two specimens at a station. The shells are rather heavy and inflated, though the hump on the disk, which is characteristic of the species, is not nearly as prominent as in some specimens from the Washington collection obtained by Mr. Boepple in the Clinch and Holston Rivers. Some of the shells are beautifully rayed, especially

anteriorly, but the greater number are too deeply stained for the rays to show. In the living animal the mantle is prettily rayed.

The shape, size, and solidity of the shell of this species make it suitable for the manufacture of buttons, but unfortunately it is too brittle and hard, resembling *Pleurobema æsopus* in this respect. About one-third of the shell, moreover (the tip part), is of a pink tinge, which runs entirely through the shell, making it of no value.

42. *Dromus caperatus* (Lea). Fan mussel.

The examples of *Dromus* obtained in the Big South Fork of the Cumberland differ from those found in the main river by being considerably flatter, with the hump on the disk less pronounced or nearly absent. These flattened shells represent the species *caperatus* (Lea). Our series indicate that the two forms run together. In young specimens, before the step-off is formed, it is doubtful if *dromas* and *caperatus* could be distinguished.

From what has been said concerning the relationship between this and the preceding species it may be readily inferred that this species also, from a commercial standpoint, is valueless.

43. *Strophitus edentulus* (Lea). Squaw-foot.

We found only a few examples of this species. It has a fragile shell, which disintegrates quickly and is probably more common than our small collection would indicate. Mr. Boepple found it at Pineville, the highest point at which the river was examined. It is a species which occurs in all sorts of situations—in both small and large streams and in lakes. Two of our specimens have a pink-purple nacre; in the others it is of a yellowish cast. The species is of no value on account of its thin, brittle shell. It is exceedingly variable, and presents many puzzling forms. According to Mr. Bryant Walker our specimens represent the form *shaefferiana* Lea.

44. *Anodonta imbecillis* (Say).

The distribution of this fragile, beautiful species is almost identical with that of *A. grandis.* Of the two found in Haynes Lake one was gravid (Sept. 3). The glochidia are rather large, chestnut-shaped in outline, brown, and fill the entire outer gills. The species remains gravid through the winter. The Haynes Lake shells contained several *Atax* apiece.

45. *Anodonta grandis* (Say).

This species was not found in the main river. In general, conditions throughout the whole Cumberland system are not favorable to its development. The small tributaries are too swift and rocky, and the Cumberland itself is lacking in the quiet, muddy sloughs in which *A. grandis* can thrive. The only river examples we found were in the Stones River, a few in the East Fork near Walterhill, Tenn., and several in the West Fork near Murfreesboro. At the last-mentioned place it had apparently once been abundant in the vicinity of the railroad bridge, where it had thriven in the mud of the deep, quiet pools among the water-willows. A number of shells, recently killed by pearlers, were lying on the bank. These were large, heavy shells, unusually thick for the species, and varied considerably in shape, some of them being markedly elongate.

In Haynes Lake, a shallow, muddy pond below Clarksville, *Anodonta grandis* was fairly abundant, and about 30 examples were secured. These were more shapely, of a larger size than those from Stones River, and much thinner. They are indeed the largest and finest examples of the species we have ever seen and represent the form *gigantea* Lea. The largest example measured 201.3 mm. long, 112.5 mm. high., and 82.3 mm. in diameter. These shells are peculiar in having two distinct colors of nacre, about half of them being dark purple, while the other half are a beautiful, lustrous, creamy white. The reason for this difference is not apparent; parasites are almost entirely absent.

46. *Lastena lata* (Rafinesque).

Very few examples seen in addition to those enumerated in the table. Mr. Boepple obtained it at Burnside, Albany Landing, and Cloyds. Its apparent scarcity is due in part to its habits. It can not be caught on the crowfoot hook, but must be obtained by wading, and is best secured when the water is low and clear. The species appears to prefer gravel bars with a rather swift current. The shell is beautifully polished and rayed, and is very thin, cracking easily when exposed to the air. Our examples are rather badly eroded.

47. *Anodontoides ferussacianus* (Lea).

Rare; only a few specimens found. A thin, fragile *Anodonta*-like shell of no commercial value.

48. *Pegias fabula* (Lea).

A rare species of which we found only two living and four dead specimens in the Rock Castle River near Livingston, Ky. They are quite small, the smallest measuring 22.7 mm. long, 15.5 mm. high, and 11 mm. in diameter, and the largest 31 mm. long, 20 mm. high, and 14 mm. in diameter. In their perfect condition these must be very attractive little shells, but our specimens are very badly eroded.

49. *Symphynota costata* (Rafinesque). Fluted shell.

Occasional in the upper Cumberland from the falls down to the foot of Gowers Island. Occurs typically in moderately small streams and appears to be entirely absent from the lower stretches of the Cumberland. It is rather common in the various tributaries. The Stones River shells were exceptionally thick and heavy, and bore a goodly number of dead or soft pearls.

On account of its yellow nacre and tendency to crack this species is of no use in the manufacture of buttons.

Several of our specimens have numerous deep wrinkles extending ventrally over the posterior half of the disk. One is unusually shortened, truncate posteriorly and produced forward, and has well-marked rays, while another medium-sized shell from a mile below the falls is unusually elongate.

50. *Symphynota complanata* (Barnes). White heel-splitter.

Rare; only two examples of this species were found in the entire Cumberland. The shells were small, thin, and badly stained. These were obtained on Red Rock bar below Clarksville. Fragments of large strong shells were found in the Harpeth River. This species thrives in a muddy bottom and is often found in sloughs. Under especially favorable conditions it produces a fairly thick large shell which furnishes usable button material, but the Cumberland shells of this species have no value.

51. *Alasmidonta minor* Lea.

Confined to the upper river and tributaries. So far as our experience goes, this species is found typically in small streams, living in the sand between rocks. It may live along the border of large streams, but on account of its small size would be easily overlooked. Most of the specimens found had been killed by muskrats. The shells were all badly eroded and so deeply stained that the characteristic rays were obscured and the nacre rather badly stained.

This species is always too small to have any commercial value. Our smallest example measures 17 mm. long, 11 mm. wide, and 6 mm. in diameter, and our largest 45 mm. long, 28 mm. wide, and 18 mm. in diameter.

This species closely resembles *A. calceola*, a better known and more widely distributed species, but has a heavier shell and teeth and darker epidermis, and is somewhat flatter and longer.

52. *Alasmidonta truncata* B. H. Wright. Elk-toe.

This is not a common mussel in the Cumberland and is, generally speaking, a species of rather small streams and the upper courses of larger rivers. All the shells found were dwarfed, very thin and eroded, and with the epidermis rather badly stained.

When well developed this is an attractive shell, but it is always too thin and fragile to have any commercial value.

According to Mr. Bryant Walker, there is no difference between this and *A. marginata* Say, and our thin dwarf specimens lend probability to this view. As we have seen but few *marginata* we have no means of comparing them. As Simpson has separated the two forms, however, and ours are within the geographic range of *truncata*, we retain for the present Simpson's name.

53. *Margaritana monodonta* (Say). Spectacle case.

Occasional from Snows Island, where we first encountered it, as far down as Dover and perhaps beyond. The shells are fragile and break and crack easily, and disappear soon after dying. The species has no commercial value.

54. *Unio gibbosus* Barnes. Lady-finger; spike.

Unlike *Unio crassidens* this species is not especially abundant in the Cumberland. Though distributed throughout the entire length of the river, at many stations only a half dozen specimens were found, and nowhere did it rise above 4 per cent of the entire catch. In the Cumberland above the falls it is about the only species found. In the Clear Fork at Jellico, Tenn., and Savoy, Ky., it was abundant, forming about 90 per cent or more of the entire mussel population, and numerous dead shells recently killed by muskrats were found along shore and at the base of the water-willows.

These Clear Fork examples were all small dwarf shells with a rather pale nacre. They approach a well-marked form found in Green River, Ky., and other southern streams. The Clear Fork flows through sandy and shaly country and the water may be too deficient in lime to promote good shell growth. Immediately below the falls we encountered the normal full-grown form which is the one of the main river.

Gravid examples of this species were found during the entire summer.

55. *Unio crassidens* Lamarck. Elephant-ear.

Exceedingly abundant, especially in the upper part of the river. It is a species of large streams, and we did not find it in any of the tributaries nor above the falls. In the upper part of the river this shell is a decided nuisance, forming a large part of the clammer's catch, taking much of his time and labor and yielding little in return. It is generally known as the "pink," and clammers, on their prospecting cruises, note down the percentage of "pinks" and "whites," from which to judge the value of a bed. It is the great abundance of this species that makes the section of river from Burnside to Celina unprofitable clamming, and the problem of making this stretch a valuable clamming ground consists as much in the reduction of this species as in the increase of valuable kinds.

U. crassidens exhibits considerable modification as one ascends the Cumberland. In the lower stretches of the river most of the shells are the rather elongate form, which seems to be most common the country over. As one advances upstream these elongate shells gradually give way to a short and chunky variety.

The shells from Half Pone bar and a few from Mill Springs and Salt Lick bar show rather well-marked rays; most of the others are rayless.

Occasionally shells with the nacre very pale or almost white are found. These are called "white-pinks" and are acceptable to the buyer. Even the more or less markedly pink ones are beginning to be used, but there is little demand for them and they always bring a rather low price. The shells work up exceptionally well, being soft and free from grit.

While at Clarksville we were informed that the superintendent of one of the smelting furnaces along the river had been trying cull shells as a flux and found them satisfactory. It is doubtful whether this utilization, however, will make an important market for them.

56. *Pleurobema clava* (Lamarck). Club-shell.

Generally rare, and not found at all below Burnside. The shells are all badly eroded and discolored; one of them is unusually elongate, and several show a rather well-marked, broad and shallow furrow in front of the posterior ridge. We have usually found this species most abundant in small streams, and this may explain its absence from the greater part of the Cumberland. It is a rather handsome shell but too small to have any commercial value.

57. *Pleurobema crudum* (Lea).

This species does not appear to be common or widely distributed. All our examples are rather small shells, somewhat resembling a much-flattened *Quadrula subrotunda*, but with the epidermis of a brighter yellow and the rays quite distinct, well defined, and broken up into blotches.

58. *Pleurobema æsopus* (Green). Bullhead.

We did not see many examples of this species in the Cumberland, but it is common enough to be well known among the clammers. In the upper Mississippi it is called "bullhead" or "sheepnose," and is used in button manufacture, although it is ranked as a rather low-grade shell on account of its brittleness. In the Cumberland it is so hard and flinty that no attempt at all is made to cut it as it breaks saws. The clammers call it "clear profit" because they are "the only ones who get anything out of it." A small example obtained at Half Pone bar was of a beautiful yellow color; the older ones are brown.

The systematic position of this species is in doubt. It seems to stand between *Quadrula* and *Pleurobema*. Simpson [a] was not certain as to where to place it, having seen only one example gravid, and it with the gills partly filled. At the biological station at Fairport one was found with only the inner gills filled with glochidia and another with all four. Sterki [b] has found glochidia in all four gills. Usually, however, only the outer gills are used as a marsupium.

59. *Quadrula tritogonia* (Barnes). Buckhorn; pistol grip.

This is the *Tritogonia tuberculata* of Simpson's Synopsis. At the time the Synopsis was written the gravid female was not known. The shell stood pretty much by itself, and Mr. Simpson, who was struck by certain peculiar features, especially the noteworthy difference between the male and female shells, formed a separate genus for it. Since the discovery by various students that it bears young in all four gills, there is a general tendency to place it in the genus *Quadrula*, and Dr. Ortmann, who was the first to propose the shift, suggested the name given above. The species is quite aberrant; none of the other *Quadrulas* resemble it very closely, the nearest approach being some of the elongate *Quadrulas* such as *cylindrica*, especially the rough subspecies *strigillata* or *Quadrula trapezoides* from the south. The marked difference between the males and females is unique among any related forms and entitles it at least to subgeneric rank.

This species is not rare in the Cumberland and was obtained in small numbers at most of the stations from the falls down to Dover. Our specimens are mostly of medium size and a number have the nacre rather badly stained. They exhibit but little variation among themselves or from the form as generally known. The nacre of all but two is white; in these two, obtained near Clarksville, it is pink.

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[a] Synopsis of the Naiades, Proceedings of United States National Museum, vol. XXII p. 745 and 764.

[b] According to Ortmann, Nautilus, vol. XXII, no. 10 Feb., 1909, p. 100.

Where it attains its best development, the buckhorn is an excellent button shell, indeed one of the best. It does not find the most favorable conditions for growth and development in the Cumberland, however. It is not as yet amenable to propagation on a large scale, as it is but rarely that one finds gravid examples.

60. *Quadrula perplicata* (Conrad).

The plicate *Quadrulas* of the Cumberland, especially the middle portion of the river, are rather peculiar shells, lying somewhere between typical *plicata* and *undulata.* The beaks are too low and flattened for *plicata* and the shells are too heavy and a trifle too inflated for *undulata.* A marked feature about them, in addition to their general rotundity of outline, is the fact that they usually taper to a point posteriorly. The clammers call them the "round-lake," and say that in proper conditions they are good pearl bearers. The folds are few and gently rounded. Mr. Bryant Walker, who examined them, is of the opinion that they are *perplicata.* We obtained some good specimens at Meeks Spring bar. Our largest measures 119 mm. long, 86 mm. high, and 56 mm. in diameter. At Half Pone bar a particularly interesting and instructive lot of young shells were obtained. These are inflated and rotund, approaching a spherical form with a greenish epidermis. Though quite small, they are so worn at the umbones that they look like old shells and no beak sculpture is shown. The smallest measures 17 mm. long, 15 mm. high, and 10 mm. in diameter. Farther up the river, at Cloyds Landing, this shell approaches *undulata,* while in Stones River, near Murfreesboro, the real *undulata* is found.

The shells are thick, solid, and heavy, but the nacre is spotted and they form rather poor button material. If they could be obtained free from spots, they would have a good market value.

61. *Quadrula undulata* (Barnes). Three-ridge or blue-point.

Beautiful examples of this species are common in the West Fork of Stones River near Murfreesboro, Tenn. It is also found in the East Fork near Walterhill. The young examples are yellowish brown, well compressed, and entirely free from erosion, so that the umbones show the sculpture very plainly. This consists of four or five high, coarse ridges, the first-formed ones crescentic, the older ones gradually vanishing backward until the last one is a short, low tubercle. The undulations are deep and crossed by numerous small furrows. A noteworthy feature of these shells is the great distance of the pallial line from the margin. The shells are somewhat spotted, but the spots are small and they would yield a fair amount of good button material.

62. *Quadrula heros* (Say). Washboard.

This is a species of large rivers. It is not found in the upper part of the Cumberland, but is abundant in the lower river. The first we saw was at the Mill Springs bar.

This species bears the largest and heaviest shell of the North American Unionidæ. It becomes rather large in the Cumberland, but not as immense as in the Wabash and some parts of the upper Mississippi. Our largest shell measures 162.8 by 115 by 62.4 mm. Our collection exhibits little variation. From the unusually large number of small examples seen it appears that the species is exceptionally prolific in the Cumberland, especially about Half Pone bar and Owl Hollow bar above Clarksville. All our examples are somewhat eroded at the umbones, but only two or three badly. The young examples are noteworthy for having the finely waved broken sculptures, characteristic of the umbones of the older specimens, over the entire disk and the plications rudimentary or only faintly developed, so that they do not closely resemble the old.

We found no gravid examples. They are indeed very rarely found, and nothing is known at present about its spawning habits or as to what fish acts as host to the embryos.[a]

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[a] Since the above was written investigators at the Biological Laboratory at Fairport have thrown considerable light on the breeding habits, hosts, etc., of this species.

In some rivers, as parts of the Illinois, this shell does not become stained early, and the younger shells furnish excellent button material. For the common run of buttons this shell is becoming one of the most important species, as its large size and expanse allows it to be worked up readily into buttons of various sizes, and the stains can be bleached out or the buttons "smoked" or artificially dyed. In the Cumberland the nacre becomes badly stained, even when the shell is quite small, and the washboards are always sorted out and sold separately as low-grade shells, bringing but $2 to $5 per ton when first-grade shells are bringing $6 to $8.

But few parasites were found, and we have as yet no clue to the cause of the discolored spots on the nacre. These spots are usually circular in outline and frequently have what appears to be a foreign body in a small raised pustule at the center. The fresher stains, or those near the surface, do not really permeate the nacre, but are composed of a flat hornlike skin overlying it and can be softened by acids and scraped away from the unstained shell beneath. The older, duller stains are doubtless the same thing covered by layers of nacre.

Many of our specimens are interesting as showing with unusual clearness the path, during growth, of the posterior adductor muscle scar, the anterior border of which is dimly defined, while straight converging lines from the dorsal and ventral borders of the scar lead up into the umbonal cavity. One of our specimens has a pinkish nacre.

63. *Quadrula cylindrica* (Say). Rabbit's-foot.

Occasional to abundant in the upper part of the river. On account of its narrow cylindrical shape it is of little value for buttons; the nacre, moreover, is frequently diseased and stained. The flesh is usually orange yellow and the gills, when filled with glochidia, markedly so. Some of our examples are well covered with small tubercules over the anterior portion of the disk, approaching the subspecies *strigillata*.

This is a rather active species, the most active of the *Quadrulas*. Its elongate form, in which it differs markedly from its nearest relative, *metanevra*, and indeed from all Quadrulas in general, may be an adaptation to an active life.

64. *Quadrula metanevra* (Rafinesque). Monkey-face.

This well-known button species is fairly common. A few were to be found at nearly every station, clam pile, or mussel bed. It was not abundant enough, however, to form more than a sprinkling among the shell piles, and it cuts a rather small figure in the button industry of the Cumberland. On account of its luster and solidity it is very acceptable to the manufacturers. It would not be worth propagating, however, as there are plenty of better species. We found one example of this species gravid on the last of May.

65. *Quadrula tuberosa* (Lea).

Rare and collected only in the upper river. In the autum of 1910 Mr. Boepple obtained it at Sloans Shoals in the South Fork near Burnside, at Selfs Bar, and at Cloyds Landing.

66. *Quadrula fragosa* Conrad.

This species is occasional, and in some places abundant, in the lower Cumberland. It does not appear to "bite" readily on the crowfoot hook and the few examples taken by clammers are apparently no indication of its abundance. Small mussels of this species are a favorite food of the muskrat. Of a large pile of shells cleaned out by these rodents near Meeks Spring Bar, nearly all were this species and *Obliquaria reflexa*, although other mussels appeared to be common in the vicinity.

This species is very similar to *Quadrula lachrymosa* (Lea) and the differences between the two are difficult to express either by description or figure. It is somewhat more square-cornered, more inflated, and the tubercles on the posterior slope are more markedly arranged in rows, forming costæ. This species does not become as large as

Q. lachrymosa and is of little commercial value. We found gravid examples below Kuttawa May 17 and at the foot of Dover Island May 29. All four gills serve as marsupia and are thick and pad-like.

67. *Quadrula pustulosa* (Lea). Warty-back.

Common throughout the entire length of the river. Our shells exhibit a marked uniformity in general appearance, being rather inflated with only a moderate number of low tubercles. A few shells found a mile below Cumberland Falls are almost entirely smooth. With the exception of the Half Pone Bar specimens most of the shells have a cloth-like epidermis.

The warty-backs of the Cumberland are as a rule rather undersized, and their inflated form is something of a disadvantage, so that they are not as valuable as in some other streams.

68. *Quadrula cooperiana* (Lea). Cumberland pigtoe.

Not rare in the Cumberland. The proportions of the shell vary considerably, some being higher than long and others longer than high. The older examples are generally more elongate than the younger. The shells also vary somewhat as regards degree of inflation. One of the young shells has the epidermis faintly rayed, the others are eradiate. Three of the shells have the epidermis polished and shining; in the others it is dull. The nacre is sometimes a pale suffused pink within the pallial line, but in the majority of cases it is pure white. This is regarded as a very fair button shell. In appearance it lies intermediate between *pustulosa* and *granifera*. From *granifera* it can always be distinguished by the color of its nacre. It is usually longer and flatter than *pustulosa*, and there are peculiarities of epidermis, disposition of pustules, and shape of teeth that taken together help to separate them. They can always be separated if in the flesh, as *cooperiana* always has an orange-yellow flesh. The ova which fill the gills are bright yellow.

We found only two examples gravid, early in June. The developing ova were borne in the outer gills and gave it a sulphur-yellow color.

Dr. Ortmann removes this species from the genus *Quadrula* and places it in *Pleurobema;* he remarks that it is closely related to *P. æsopus*. We are rather favorably inclined to this view, but in view of the fact that these two genera need a thorough revision and may possibly run into each other we prefer at present to leave it where Simpson placed it, among shells that it strongly resembles.

69. *Quadrula rubignosa* (Lea). Wabash pigtoe.

This species was found nowhere except in the East Fork of Stones River at Walterhill, Tenn. The shells show very little difference in general appearance, except that in the smallest the posterior ridge is poorly defined, and one of the medium-sized examples is somewhat more rounded, and has a lower posterior ridge. Large examples of this species make a moderately good button shell.

70. *Quadrula undata* (Barnes). Pigtoe.

This, as Bryant Walker has shown,[a] is the proper name for the *Quadrula trigona* (Lea) of Simpson's Synopsis. Ortmann[b] regards it as a subspecies of *Q. rubiginosa*. Though we have observed great variation in this shell, we have never seen any transition forms between the two species. It is rare in the Cumberland and the shells are rather small, measuring about 45 mm. long, 43 mm. high, and 25.7 mm. in diameter. The epidermis is clothlike and finely striate. The flesh is orange, in which respect it approaches *rubiginosa*.

An example procured at Linton, Ky., had a dorsal baroque, and the mantle contained 4 marginal distomid cysts, a parasite which is especially frequent in this species.

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[a] Nautilus.

[b] Nautilus, vol. XXIII, no. 9, Feb., 1910, p. 116.

Where the pigtoe is found in abundance, as in some parts of the upper Mississippi, it is used quite extensively in the manufacture of buttons. It yields only a few blanks per shell, however, and would not be a desirable species to propagate.

71. *Quadrula obliqua* (Lemarck). Ohio River pigtoe.

This is the most abundant, and, on this account, the most important, commercial species in the river, especially in the central portion, where it greatly exceeds any other species in number.

The Ohio River pigtoe is a very good button shell. It is inferior to the niggerhead, both in luster and form, the sulcus on the side and the thinning out at the tip making it of unequal thickness; but, with the exception of the niggerhead, it is one of the best species.

It is a rather prolific breeder. We found more gravid specimens of this than of any other species. The height of the spawning season is during the latter half of May and the earlier half of June. Occasional examples, however, may be found during the entire summer. Of five examined at Beasleys Shoals August 9, four were gravid. The portion of the gills used as marsupia varies greatly in different examples; it may depend upon the amount of ova fertilized and upon the age of the mussel. In some of the mussels the lower half of the outer gills are filled; in other cases the entire outer gills and quite frequently all four gills. Occasionally three gills, the two outer and one of the inner, contain eggs or young. There are no well-marked sulci between the conglutinates, which are rather thin and flat, resembling the seed of the green cucumber in general appearance. They are peculiar in that, when viewed from the side, they present a wavy appearance. This, so far as we know, is found only in the present species and enables one to distinguish the conglutinates even when found free from the animal. The wavy appearance is due to little pits in the anterior and posterior faces. A conglutinate of this species was found lying on the gravel bar in shallow water at Half Pone Bar June 16; the species was therefore spawning at that date.

Dr. Ortmann has removed this species from the genus *Quadrula* and placed it in *Pleurobema*. All the examples he had examined up to that time had glochidia in the outer gills only. According to the data given above, its transfer to *Pleurobema* seems hardly advisable until the whole group is more thoroughly revised.

72. *Quadrula coccinea* (Conrad).

What appears to be an oblique form of *Quadrula coccinea* occurs rather frequently in the Big South Fork opposite Parkers Lake Station. Similar forms occur in the upper Cumberland down as far as Tear-coat Bar. In the main river these forms run into others in inextricable confusion, and nothing definite can be said about this species from the material at hand.

Dr. Ortmann is of the opinion that *Quadrula coccinea* is a variety of *Q. obliqua*. In some of the northern rivers it seems to be a fairly constant and well-defined form.

73. *Quadrula solida* (Lea).

Only occasional. We obtained a few, principally at Indian Creek Bar. The shells were not typical and differed considerably from those found in the upper Mississippi. The sulcus is very faint, and the nacre is not white but varies from pale rosy to purplish red.

74. *Quadrula plena* (Lea).

This appears to be a rare species in the Cumberland, and we obtained only a few scattered shells. They are all small and resemble very closely a much-shortened *Q. obliqua*, the compressed posterior portion being very short and the height of the shell being very great, considerably exceeding the length. The nacre is pale rosy.

Mr. Boepple obtained this species in 1910 from Fords Island down to Martinsburg in the upper part of the river.

75. *Quadrula pyramidata* (Lea).

Rare; we obtained a few examples in the vicinity of Mill Springs Bar. Our specimens have a broad furrow on the posterior half of the shell and differ from *Q. obliqua*, which they otherwise much resemble, by the umbones projecting far forward. They agree quite closely with Conrad's figure and description[a] of *Unio mytiloides* which Simpson regards as a synonym, except that the epidermis of our shells is black rather than brown and umbones are badly eroded.

This is a very perplexing species. The extreme form, which, if it were only constant, would represent a very well marked and easily recognizable species, resembles an immensely overgrown *Pleurobema clava* in general appearance. Such specimens are rare; we have a few in the Washington collection. Our shells represent a sort of intermediate form between that and *Quadrula obliqua*.

Mr. Boepple obtained examples from several stations in the upper river, to which portion it is apparently pretty well confined.

76. *Quadrula subrotunda* (Lea).

The young of this species have a general resemblance to *Quadrula ebena*, the niggerhead, but can be distinguished by their polished epidermis and broken rays near the umbones. We obtained only a few examples of these easily recognized shells.

What is probably the adult of this species is occasional through the length of the river. We have not been able satisfactorily to connect the small shells with the large ones through a perfectly unbroken series, but up to the present can think of no better disposition to make of them. They have a black epidermis, with the umbones generally more or less eroded, and very much resemble an elongated *ebena*. These large shells are fairly common in the upper stretches of the river. A peculiarity of the old mussel is the rich orange color of the soft parts. At the blank factory at Clarksville they are known as the "long solid" and are regarded as one of the best button species of the river. None were found gravid. If they were to prove amenable to propagation, they might be profitable to plant in the upper part of the river and in similar situations where *ebena* would not thrive.

77. *Quadrula ebena* (Lea). Niggerhead.

This important commercial species, which is generally regarded as the producer of the most valuable shell for the manufacture of buttons, is absent in the upper Cumberland, and is abundant enough to be of considerable commercial importance only in the lower stretches of the river.

The niggerhead is a deep-water shell and is rarely found in small rivers, or in such mussel beds as are found in shallow water. It seems in general to prefer mud to sand and gravel, and the percentage collected depends much upon the methods of collecting. Work in deep water will bring to light a larger percentage than wading or gathering by hand or a rake.

The breeding season in the Cumberland begins in May and extends through the greater part of June, perhaps longer. In this species the condition of the development of the young can be roughly estimated by the appearance of the gill. When the ova pass down into the gill they are at first red, or carmine, probably because of an abundance of food material; as the glochidia develop they gradually fade out until the gills of a fully ripe niggerhead are of a dirty white color.

There is not much variation in shape among the shells, some being elongate and others more rounded than the average. The shells show very little erosion, and the young exhibit the peculiar white patch near the umbone, as has been fully described by Lea. The nacre is rather frequently stained brown, and nearly all lack uniformity in thickness, the shell thinning out somewhat abruptly a little behind the middle of

[a] Conrad, Monograph, p. 41, pl. XX.

the ventral margin, leaving thin tips. The shell is easily distinguished from any other species in the river except from old examples of *Q. subrotunda,* which are always more elongate and always have yellow flesh.

Q. ebena would probably thrive only in the lower parts of the river, although when the propagation of this species becomes feasible it may be worth trying in the upper river.

78. *Quadrula tuberculata* Rafinesque. Purple warty-back.

A careful study of our material, as well as of the evidence at hand from the literature, convinces us that *Q. granifera* and *Q. tuberculata,* though quite markedly distinct in typical cases, are really connected by intermediate forms. In some rivers, like the Tippecanoe at Delong, Ind., only strongly marked *tuberculata* are found. In others, like the Mississippi about Fairport, Iowa, only well-marked *granifera* are found. In such streams or portions of streams as contain both species they are indistinguishable, or so connected by intergrades that no clear line of demarcation can be drawn between them. In the Cumberland, the first shells seen, in the lower part of the river, were identified provisionally as *granifera;* as we ascended the river some doubts as to the species began to appear, while in the upper tributaries the shells were pretty clearly identified as *tuberculata.* This naturally introduces the question as to influence of environment on shell form, which may be touched upon briefly here.

The most striking and essential difference between *tuberculata* and *granifera* is one of degree of inflation, *tuberculata* being a flat form and *granifera* much inflated. We have a number of cases among the Unionidæ where two otherwise similar shells are distinguished by this feature; among these are: *Q. plicata,* inflated, *Q. undulata,* compressed; *D. dromas,* inflated, *D. caperatus,* compressed. From our experience we are inclined to believe that one usually finds the compressed species in small streams, while the more inflated forms are found in large rivers. Often when a main stream has *plicata,* the little tributaries will have *undulata,* especially if they are rather shallow and swift streams with gravel bottoms. The more compressed form is better adapted to plow into the gravel or crawl under rocks and hold its position in a swift current, where the inflated form would present too much surface to the force of the water. In the softer mud and weaker current of larger streams an inflated form would be advantageous, helping to buoy up the animal.

To state the situation precisely as we have found it, if one takes one of the larger rivers from source to mouth, and finds both *tuberculata* and *granifera* or *plicata* and *undulata* in the stream, the compressed form is likely to be in the upper stretches of the river while it is a small swift stream, and the more inflated form farther down in the main body of the river where the bottom contains more mud and the current is slower. Extreme forms of either species, so far as we know, are never found in the same bed, but where both are represented the forms run together.

The literature relating to *granifera* and *tuberculata* is exceedingly interesting, but too long to give in detail. To understand the present status of the group, however, it is necessary to state that Simpson in his Synopsis removed these two species from the *Quadrula pustulosa* group, where they had been previously placed, making of them the subgenus *Rotundaria* on the basis of a "well-developed sulcus on the posterior slope and remarkable beak sculpture." The beak sculpture is well marked on *tuberculata* but not so well, or almost absent, on *granifera.* Ortmann, finding only the outer gills used as marsupia in *tuberculata,* raised *Rotundaria* to generic rank. We have usually found only the outer gills of *granifera* at Fairport marsupial, although we have a record of one example with marsupia in all four gills.

The species does not reach a very large size in the Cumberland. On account of its purple nacre it is of no value for buttons.

FISHES AND FISHING IN SUNAPEE LAKE

By William Converse Kendall
Scientific Assistant, United States Bureau of Fisheries

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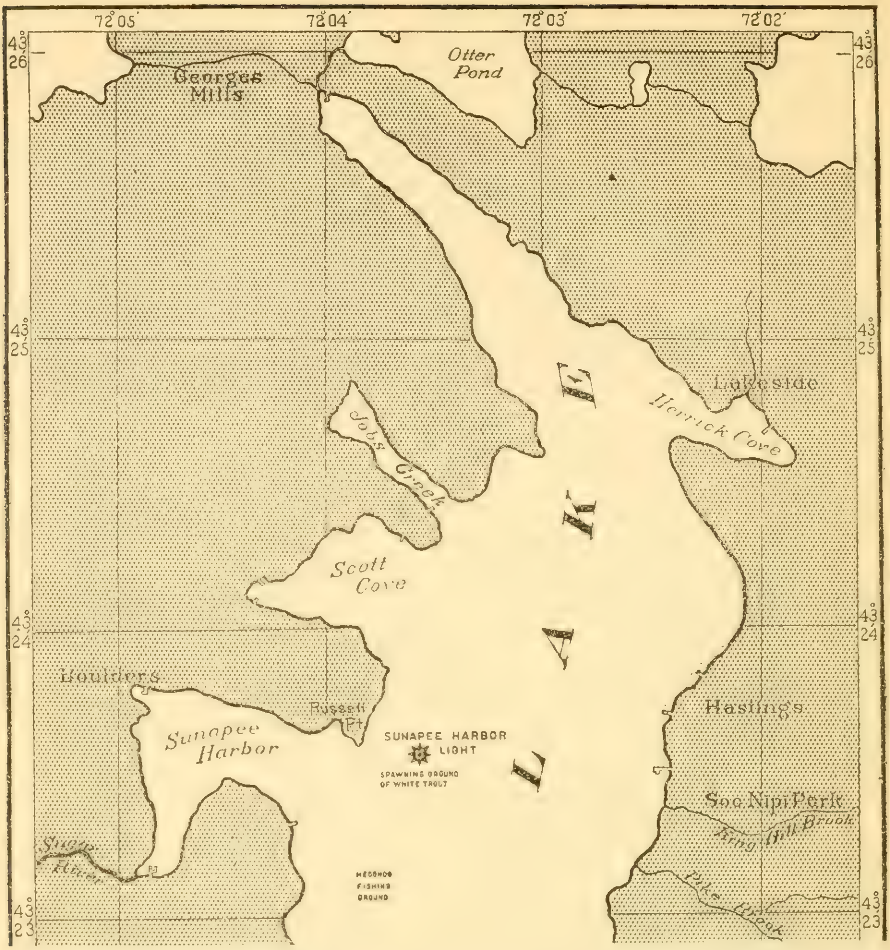
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FISHES AND FISHING IN SUNAPEE LAKE.

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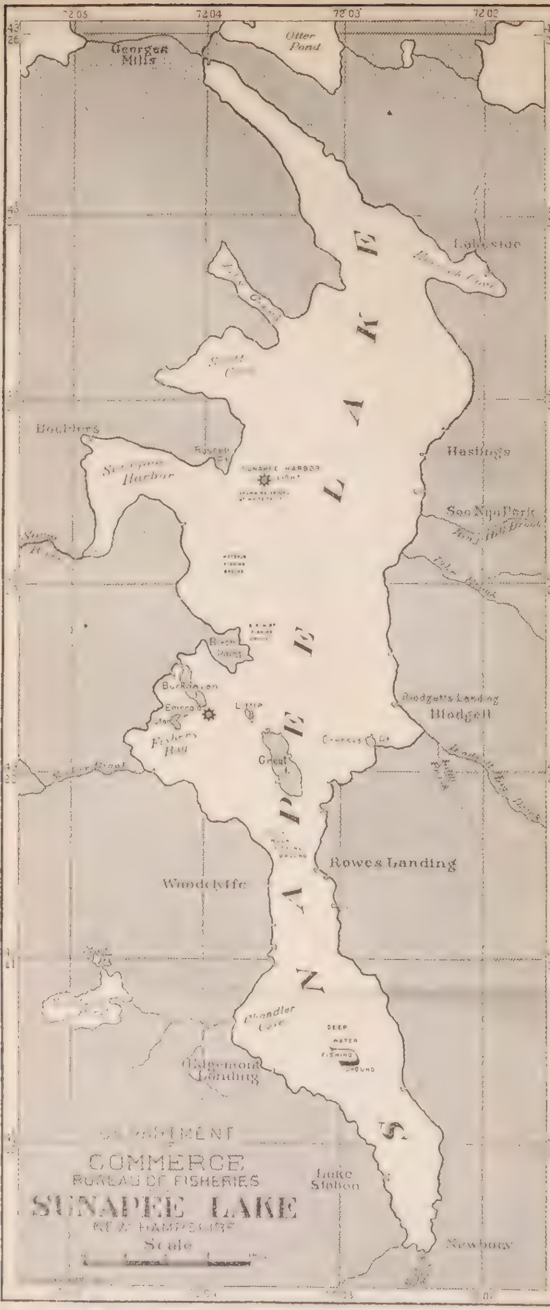
PHYSICAL CONDITIONS IN THE LAKE.

Sunapee Lake is situated in the highlands of Sullivan County, New Hampshire, on the divide between the Merrimac and Connecticut River basins, at surface elevation of 1,091 feet above the level of the sea. It is surrounded by low mountains, highest on the west of the lake, the loftiest being Sunapee Mountain on the southwest side of the southern end, with its highest peak 2,743 feet above sea level. The lake is bordered at its northern half by the townships of New London on the east and Sunapee on the west, the dividing line between these running southward through the lake, and the latter extending to the upper end of "The Narrows," a little over a mile farther south than New London. The remainder of the lake is comprised in the township of Newbury. The principal villages of post-office importance are Newbury, at the extreme lower end of the lake, and Sunapee Harbor, at the head of the outlet. The Claremont division of the Boston & Maine Railroad has an all-the-year station at Newbury and a summer station at Lake Sunapee, the steamboat landing being 1 mile distant on the west side of the lower end of the lake.

A greater part of the shore is occupied by summer residences and hotels, and there are some considerable colonies or villages.

Sunapee Lake is but a little over 8 miles long following the course of the lake (although it is reputed to be 9), and its greatest width from Soo-Nipi Park pier directly west to Russell Point, which marks the upper outer end of Sunapee Harbor, is 1¼ miles.

From the mouth of King Hill Brook to "The Hedgehog," just south of the entrance to Sunapee Harbor, in a slightly southward course, it is just about 1½ miles, and disregarding the islands, from the mouth of Blodgett Brook in Blodgett Cove directly west to the head of Fishers Bay it is 1.8 miles. From Soo-Nipi Park pier shore end directly west to Boulders in Sunapee Harbor it is 2.1 miles, and continuing south to Sunapee Harbor landing it is six-tenths of a mile farther, but the distance by boat from Soo-nipi Park to Sunapee Harbor landing is 2¼ miles. From Hastings on the east side to head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SUNAPEE HARBOR LIGHT
Blodgett's Landing
Blodgett
Great I.
Rowes Landing
Chandler Cove
DEEP WATER FISHING GROUND
Lake Station
Newbury
COMMERCE
BUREAU OF FISHERIES
SUNAPEE LAKE
Scale

of Gardner Bay (Scotts Cove) it is nearly 2 miles. From Georges Mills southwest to inner end of Herricks Cove, just below Lakeside, it is 2.3 miles in a direct line.

Dunnings Point marks the western outer end of what might be considered a deep cove extending from the main lake northwestward to Georges Mills, a distance of 1.6 miles. Some seven-tenths of a mile below Dunnings Point is another point marking the upper or north side of the entrance to Jobs Creek, a narrow cove extending about seven-tenths of a mile inland northwestward, and only about one-tenth of a mile wide at the entrance, although widening up some at the inner end.

Scotts Cove is a rather wide, deep bay.

The lake may be considered to consist of two expansions connected by "The Narrows," the larger one being the northern expansion and the smaller the southern. The narrowest part of "The Narrows" lies between Woodclyffe on the west side and Rowes Landing on the east, a distance of about three-tenths of a mile, and at a distance of about 2½ miles from Newbury.

The southern end of the northern expansion is somewhat broken up by islands of various sizes, the largest of which is Great Island, which limits the steamer channel on the west side. The island is nearly one-half mile long by two-tenths wide, its southern end only something less than two-tenths of a mile removed from the mainland on the east side of the lake. Fishers Bay, directly west of this island, is shallow, and the space between the island interrupted by reefs. The real northern expansion may be considered to lie at the north of Birch Point on the west and Echo Point (Cressy's) on the south-east (the southern point of the outer end of Blodgetts Cove). Below The Narrows the widest part of the lake is between the outlet of Spectacle Pond (Sunapee Brook), a short distance above Edgemont, and the east shore, a distance of about nine-tenths of a mile.

The shores of the southern expansion are mainly rocky on both sides, there being a small sand beach at Newbury and muddy shores for a short distance at the mouth of Sucker Brook in Fishers Bay. On the east side the water is rather shoal and strewn with bowlders and heaps of bowlders locally known as reefs. The west side is fairly deep except in coves.

Above The Narrows, as previously mentioned, are a number of islands, and there are numerous bowlders and reefs of bowlders which probably were once small islands, with navigable passages among them.

On the east side of the northern expansion are extensive sandy beaches, forming sandy shoals for considerable though varying distances out into the lake, on the outer edge of which there is usually a rather abrupt descent into deep water.

The principal beaches, in order from the south northward, are: One extending from near Cressys Point on the south side of Blodgetts Cove to the mouth of Blodgett Brook and a little way on the north side of the cove. The shores are then rocky for about a mile to the "Owls Nest," just below the mouth of Pike Brook. Thence a beach extends to Hastings above Soo-Nipi Park with occasional short interruptions of rocky shore, especially at points. From Hastings to Georges Mills the shores vary in character, but are mainly rocky with outlying shoal water with sandy bottom.

The water on the west side of the expansion from below Dunnings Point at the entrance to Georges Mills Cove or Bay is comparatively deep and the shores are mainly rocky, as obtains even in some of the coves, such as Jobs Creek and Scotts Cove (Gardners Bay).

A large cove known as Sunapee Harbor, previously mentioned, situated about two-thirds the distance, on the west shore, from Newbury to Georges Mills, is the immediate origin of Sugar River, the outlet of Sunapee Lake, which debouches into the Connecticut River near Acutneyville post office, in the township of Claremont.

At the entrance to Sunapee Harbor are two or more rather extensive reefs of bowlders, contiguous to deep water, which were perhaps once islands. The most extensive one has more or less sand bottom mixed with the bowlders, and will be mentioned again in connection with the fish of the lake.

Mr. Henry Allen Hancox, a civil engineer of Newbury, has thoroughly sounded and accurately platted the depths of the whole southern expansion and up as far as the islands above The Narrows. Mr. Hancox kindly gave the writer a blue-print map from which the following data were obtained:

The deepest water of the southern expansion covers an area of several acres, carrying from 65 to over 80 feet of water. It lies east of the mid-north and south line and is known as the Deep Waters Fishing Ground. The deepest water in The Narrows is about 41 feet, at the northern entrance, ranging to 20 feet near the southern end mid line of the lake, just a little north of a line drawn east from Brightwood Landing.

In the portion of the lake between The Narrows and the islands is generally deep water, which obtains to not a great distance from either shore, from about 30 to over 80 feet.

Among the islands there are passages carrying from 10 to 30 feet of water.

In the summer of 1910 the writer essayed to sound the northern expansion above the islands, but abandoned the attempt owing to the unavoidable unreliability of the positions and the fact that Mr. Hancox stated that he intended soon to complete this work by sounding and platting the remainder of the lake.

The few soundings taken by the writer, however, show that the deepest water is probably about in a line between "The Hedgehog" and "Owls Nest," where the depth is something over 100 feet, varying, of course, with the height of the lake.

The white trout and salmon summer fishing grounds are contiguous to the deepest places in the lake, the principal ones being, from the north southward, Scotts Cove, The Hedgehog, off Birch Point, and Split Rock.

At Scotts Cove the ground is but a short distance from the entrance, where the depth is about 80 feet. At The Hedgehog the ground extends from not over 100 yards from shore out one-fourth of a mile or so, the depth varying from 60 to 90 feet or more. Off Birch Point the ground covers an area of 2 or 3 acres, perhaps, with a general depth of about 80 to 90 feet. At Split Rock, which is more restricted in area, not far from shore the depth is generally about 50 to 70 feet.

As is usual with deep cold lakes with rocky shores, there is very little vegetation. On the sandy shoals there are patches of varying extent of chara, and it is on the chara bottom that black bass are caught when they are caught at all on the sandy bottoms.

In protected localities, such as shallow coves, there is a more or less prolific growth of one or more species of pondweed, pipewort, etc. In the lagoonlike dead water of the mouths of some of the brooks the purely aquatic vegetation consists mainly of bladderwort, with some pondweed and bur-reed.

The quicker portions of the larger brooks contain often prolific growths of moss (*Fontinalis*) and a good deal of water cress.

TRIBUTARIES.

The meagerness of the tributary water supply indicates that Sunapee Lake must be to a large extent spring fed. There are no large inflowing streams. The largest is a brook entering the head of the lake at Georges Mills, which discharges the waters of Otter Pond and ponds connected with it.

The streams of more or less importance on the east shore, enumerated in order from Georges Mills southward to Newbury are: Two very small brooks entering Herrick Cove, one above and one below Lakeside; a very small one a short distance above Hastings; King Hill Brook, entering the lake at Soo-Nipi Park; Pike Brook, a short distance below this; Blodgett Brook and Newbury Beach Brook. In the same order on the west side are: Jobs Creek Brook; a diminutive brooklet entering Scotts Cove; one entering the north side of Sunapee Harbor; Sucker Brook, flowing into Fishers Bay; and Sunapee Mountain Brook, entering the lake above Edgemont. All are small brooks and some of them entirely dry during the summer, as they were

Fig. 1.—Upper bridge, above deadwater.

Fig. 2.—Deadwater

Fig. 3.—Mouth of brook.

KING HILL BROOK, LATTER PART OF APRIL, 1910

in 1910 and 1911. In the spring there is sufficient water in some of those that later become dry to permit smelts to ascend, which they do in enormous numbers.

All of these brooks were examined by the Bureau of Fisheries parties, but particular attention was paid to those which evidently had the most important bearing on the ecology of the lake, especially those which were natural trout brooks and have afforded in times past spawning grounds for trout, and still are the best smelt-breeding brooks, namely, King Hill, Pike, and Blodgett Brooks. These waters were studied very thoroughly in regard to their suitability for receiving the plants of young salmonids, and Sunapee Mountain Brook also was examined.

The ponds that empty their waters through Otter Brook into Sunapee Lake are: Baptist Pond, of irregular triangular shape, the apex southeastward at the outlet, seven-tenths of a mile in greatest length and about four-tenths in greatest width. It empties into Otter Pond through a stream about eight-tenths of a mile in a straight line. A small pond (McAlvins), about three-twentieths by two-twentieths of a mile, lies at the northeastward of Baptist Pond about seven-tenths of a mile distant in a straight line, but the outlet connecting it with Baptist Pond is considerably longer, owing to its irregular course. Besides this outlet tributary to Baptist Pond, which has two or more branches, there is a bog stream with a small pondlike expansion flowing into the northwest angle of Baptist Pond.

Star Lake, with two short inlets at its upper or northwestern end and a more considerable stream joining the lake near its southeastern outlet end, is situated at an altitude of 1,286 feet almost due north about 2 miles in a direct line from Otter Pond. It is about seven-tenths by five-twentieths of a mile in longest axes. Its outlet has numerous small branch brooks, and after flowing southeast a short distance turns southwestward, entering Otter Pond through a bog at its upper northwestern side. All of these are in the township of Springfield.

Little Sunapee Lake (Twin Lakes) lies almost directly east of Otter Pond at an altitude of 1,217 feet, mostly in the township of New London, but a small portion being in Springfield. In a straight line from Otter Pond to the foot of the lake it is only eight-tenths of a mile, with a drop of 92 feet. This lake is really only one lake divided about midway by a long, narrow peninsula extending from the northward side nearly across the lake; whence "Twin Lakes." The lake extends about 1.7 miles in northeasterly to southwesterly direction and is about seven-tenths of a mile wide along the previously mentioned peninsula to the opposite or south side of the lake. The lake is elliptical, though somewhat irregular in shape, disregarding the peninsula. Its principal inlet is Morgan Pond Brook, the headwaters

of which is Morgan Pond, about 2½ miles in direct line north of Twin Lake. The brook flows almost directly east from Morgan Pond for a short distance, thence turns and flows in an irregular course, but generally southward. Morgan Pond, if it were not for coves, etc., would be practically circular in shape, about three-tenths of a mile in diameter. It is situated in the township of Springfield at an altitude of 464 feet above Twin Lakes, or 1,681 feet above sea level.

About 1.1 miles in a straight line up Morgan Brook there is a small expansion into which flows a brook from the northwestward, at the head of which is a small irregular triangular pond, about seven-twentieths by four-twentieths of a mile in dimensions, the base of which is at the eastward and the outlet of which leaves the northern basal angle and flows a short distance northeastward before turning to the southwestward. In a straight line from Morgan Brook this pond is about six-tenths of a mile distant.

Twin Lakes discharges its water westward into Otter Pond. In a distance of four-tenths of a mile from Twin Lakes the stream has a fall of 49 feet, emptying into a small pond on an expansion of crescentic shape approximately four-tenths of a mile long, following the curve, and having an extreme width of one-tenth mile. In the remaining distance of three-tenths of a mile in a direct line northwestward to Otter Pond the fall is 43 feet.

The small village of Otterville is situated near the expansion just mentioned.

Otter Pond, at an elevation of 1,125 feet above the level of the sea, is situated two-tenths of a mile in a straight line from the extreme head of Sunapee Lake at Georges Mills, following the course of the outlet, which has a drop in that distance of 34 feet. The greatest descent is, however, in a much shorter distance, i. e., from the dam at Georges Mills. Otter Pond in its long axis extends 1.1 miles northwest to southeast, and disregarding the outlet cove about midway of its westward side is about one-half mile wide in the widest place. Outlet Cove, extending approximately east and west, is about two-tenths of a mile long.

Near the entrance to the outlet cove in Otter Pond, in 18 feet of water, the temperature at bottom was 64°, at surface 67°.

A very small brook at Georges Mills enters the little dead water into which Otter Brook flows a short distance northwestward of Otter Brook. It was dry August 1, 1911. The temperature on the same date at the mouth of Otter Brook was 67°. This small brook is shown in Hancox's map as the outlet of Ledge Pond, but on the United States Geological Survey topographical map the principal outlet of the pond is Ledge Pond Brook, whose waters ultimately reach Sugar River through the outlet of Long Pond not far above Newport. On the same map, however, the previously mentioned

little brook is faintly indicated as taking its rise in the same pond. Ledge Pond is irregularly elliptical in shape, nearly four-fifths of a mile in length and seven-twentieths of a mile in greatest width. It contains a number of small islands and is at an elevation of 1,306 feet above the sea.

A small brook entering the east side of Georges Mills Bay was entirely dry on August 18, 1910. But in April it was frequented by smelts and many bushels were dipped there. It is formed by two branches with bottom of coarse rocks or small bowlders above a stone bridge a few yards from the lake. Below the bridge the water of the lake extended nearly to the bridge. The smelts were caught below the bridge, as it is narrow and afforded the most favorable location for dipping, and the brook above is bordered and overhung with a tangle of alders and clematis vines.

The two brooks entering Herrick Cove seem to be fed by no permanent springs and were practically dry in the summer. It could not be learned that smelts ascended either of them, and it is doubtful if they do in this rather shallow cove, as the mouths of the brooks are so far removed from deep water.

King Hill Brook rises in the neighborhood of King Hill, from which it takes its name, and flows eastward through meadows and woodland and empties into Sunapee Lake at Soo-Nipi Park. Throughout its course the beds consist of sand and rocks. Here and there are deep pools with overhanging banks, long shallow expanses of sandy bottom, pebbly ripples, and bowlder-strewn reaches. In the lower part of its course to within a couple of hundred yards or so of the lake the country is entirely wooded, mainly with white and red pines with an admixture of various deciduous trees. Near the lake the brook is bordered by an alder growth for a short distance, thence sluggishly flows through a bushy and grassy boggy place, cleared somewhat, for the distance previously mentioned. Here the brook is much wider, some 40 or 50 feet, the bottom being composed of sand more or less covered with silt, sticks, and dead leaves. The entrance to the lake, excepting during the high water of spring, is usually obstructed by the sand beach, due to the prevailing westerly winds.

This brook in the summer of 1910 was very low and in 1911 almost dry until the latter part of July, when some heavy rains raised the water. It is a spring-fed brook, but the springs are so few and small that they do not supply sufficient water to maintain a permanent flow in the brook, although there are always pools of fairly cool water in which trout, minnows, and suckers congregate during the hot dry summer months. While the "dead water" is never entirely dry in midsummer, it becomes so heated, lying open to the sun's rays, that only such fishes as endure very warm water are found in it, and only

occasionally one of them. On September 14, 1910, in Soo-Nipi Park, the brook was entirely dry above the dead water except in a few isolated pools. On July 29, 1911, the brook was very much higher than usual.

Pike Brook rises in Sutton about 2 miles in a straight line from Sunapee Lake. It is fed entirely by springs, seepage, surface water, and rainfall. At its upper end it is a mere rivulet lying through farm land, but the greater part of it flows through woodland and meadows. It empties into Sunapee Lake a few rods south of King Hill Brook at Soo-Nipi Park. It is evidently more copiously supplied by springs and seepage than is King Hill Brook, although about the same size, but perhaps longer. Yet in summer there are often places where the brook bed is dry; but the water evidently trickles through the sand and amongst the pebbles and rocks. At its lower end there is an extent of "dead water," perhaps 300 or more yards long and 40 or 50 feet wide in places, with a sandy bottom, but its banks are wooded. In summer, like King Hill Brook, and for the same reason, the mouth is obstructed by sand. There are three rather extensive meadows in its course, separated from each other by short tracts of woodland. The first lies about eight-tenths of a mile in a direct line from Sunapee Lake, another some distance farther up, and the other not far from the head of the brook. The first one is the longest and in it are deep pools with sandy bottom; in fact the bottom is sandy in the pools of all the meadows. The meadows are grassy with only occasional clumps of bushes on the brook's brim. The most extensive woodland is below the first meadow, mainly in Soo-Nipi Park. Through the woodlands, while there are some small swampy areas, the brook flows mostly over a bed of sand and gravel and through reaches of bowlders. There are the usual long shallow and occasional deep pools, as well as ripples and miniature rapids, especially in high water. The brook in its quicker portions has an abundant growth of moss (*Fontinalis*), and water cress is common.

In the dead water the vegetation consists mainly of bladderwort, floating bur-reed, yellow pond lilies, some water hemlock, and St. John's-wort. The water of Pike Brook in the wooded sections is always cool, but in the open meadows it becomes rather warm in summer.

Blodgett Brook is represented on the United States Geological Survey topographical map as a single brook having its source in Chalk Pond. Chalk Pond is situated in the township of Newbury, about 2 miles in a direct line from Blodgetts Landing in a southeasterly direction, at an elevation above the sea of something over 1,200 feet. It is slightly and irregularly crescentic in shape, about four-tenths of a mile long by three-twentieths of a mile in greatest width. There are

Fig. 1.—A woodland pool.

Fig. 2.—Deadwater.

PIKE BROOK, SPRING CONDITIONS, LAST OF APRIL, 1910.

practically two small streams which unite just above the bridge not far from the lake at Blodgetts Landing. The north branch is locally known as "Big Brook" and the south branch as "Little Brook." Big Brook is the outlet of Chalk Pond. Big Brook was explored only to the Newbury road, about seven-twentieths of a mile from the lake at its mouth, which is all the way through woodland, and some portions, especially a short distance below the road, are a tangle of alders and vines. This branch was explored two or more times, and there was always some water in the brook, even above the road, although it was dry in many places below during the summer. Below the road it is entirely a sandy, rocky, and gravelly bottomed brook to the bridge, not over 5 or 6 feet wide in any place, and in some places so narrow that it can be stepped across. This statement pertains to the summer conditions. In the spring there is a considerable body of water flowing in it, as was seen in April, 1910, and as evinced by the extent of the dry bed. While in the spring there seemed to be more water flowing in it than in Pike Brook, due perhaps to the Chalk Pond Reservoir, in the summer Pike Brook carries far more water.

About three-twentieths of a mile up this branch is an immense stone wall called "The dam," under which is a very small culvert, through which the small brook flows. Below and near the dam were moss-grown ledges over which earlier in the season must have been a forceful waterfall.

Little Brook, which in the spring carries much less water than the other, appears to rise only a short distance from the Newbury road, in an open field. During the summer it has more water and there are deeper pools. It is evidently fed by more or larger springs. At its upper end it consisted of two short branches, one of which in midsummer consisted of detached pools of spring water; the other was absolutely dry. The entire course of this branch from the fork just mentioned to its junction with Big Brook is through woodland, and it has a bottom of sand, gravel, and some bowlders, like Big Brook. Both branches naturally fluctuate in height of water with rainfall and dry weather. In both branches there are frequent pools that are never dry, and in both in a dry season there are portions of the bottom that are entirely dry at the surface, although water doubtless trickles through to some extent. The pools, however, in Little Brook are larger and deeper, and the temperature was constantly slightly lower than in Big Brook.

The brooks, especially in the spring-fed pools, have a more uniform temperature throughout the year than the shallow water of the lake. In such a pool near the hatchery at Pike Brook on April 28 and August 18 the temperature was 50° F., the highest point reached; on October 15, 45°; and November 2, 40°, the lowest point reached, a range of 10 degrees in about six months. The range of the temperature of the

lake water near shore from April 28 to August 18 of the same year was over 30°.

The temperature of Pike Brook varied with the month and with the weather and according to the portion of the brook in which observations were made. But there was no great range of temperature, either of that taken in the same place or different places during the season or in different localities in the brook during the same day. During the summer, aside from the spring pools, the coolest part of the brook generally was where it flowed through the woods or Soo-Nipi Park, the warmest was in the dead water, and the next warmest in the meadows. On July 19 the shallow water of the first meadow registered 60° and at the bottom of a deep pool 59°. From just below the meadow, through the woods, excepting in spring-fed pools, down to Alaria Spring it was 58°; below this to and including a pool just above the dead water it was 57°. During August there was not much change from this condition, never over 2°. On the 18th the brook was constantly 57° through the woods, excepting the spring pools and the water near them, down to the broad shallow pools below the hatchery, where it rose to 58°, and the pool just above the dead water, where on July 19 it registered 57°, the temperature was 59°. The spring-fed pool near the hatchery has been referred to a number of times. It is a pool about 3 feet deep during the summer, situated a little to one side of the main current of the brook, where the water is shallow. On August 18 the temperature, as before stated, was 50° and the brook in the main current close by the pool was 55°. On the same date the dead water about halfway of its length registered 66° at the surface and 63° at bottom in 2 feet of water. At the head of the dead water in about the same depth the temperature was 60°.

Newbury Beach Brook is a small brook near the lake flowing through a small swamp. It does not seem to be a very desirable place in which to plant young salmonids. It was not learned that smelts ever ascend this brook.

Sunapee Mountain stream consists of two branches, one flowing down the side of Sunapee Mountain, steep and rocky, the other the outlet of Spectacle Pond. There is always water in the brook and always trout, but sometimes the brook is so dry that the trout are confined in detached pools and even some of these pools dry up. On one visit early in July many trout were removed from the pools and placed in deeper water below, whence they could descend to the lake. On July 26 there was more water in the brook.

Spectacle Pond is a small lake of very irregular shore line, which greatly modifies its otherwise general triangular shape, about six-tenths of a mile from apex to base and eleven-twentieths in greatest width near the base, which is the southwestward end. The pond is situated in a direct line from the widest part of the corner expansion

of Sunapee Lake six-tenths of a mile to the westward, at an altitude of 1,113 feet, thus giving its outlet, which leaves Spectacle Pond from a deep cove at the eastern side of the apex of the triangle, flowing southwest and west, a fall of only 22 feet, passing through a practically level country

Mud Pond is practically a small diverticulum of Spectacle Pond. Sucker Brook entering Fishers Bay of Sunapee Lake is practically a bog brook throughout its extent.

The brook at Sunapee Harbor is also a small brook flowing over a rocky bed, mostly through woodland, to a short dead water at the lake. The brook is ascended by smelts in the spring, but on August 17, 1910, it was absolutely dry.

Jobs Creek Brook is another inconsiderable rivulet flowing into Jobs Creek, entirely dry in the dry season.

Sugar River, the outlet of Sunapee Lake, leaves the lake at Sunapee Harbor over a considerable descent formed by a natural steep ledge and bowlder fall and a dam. For some distance below the mill and factory it is a "rocked up" or walled raceway, the bottom of which is composed of coarse gravel and blue clay. The water flows swiftly over a steep descent for perhaps one-fourth of a mile or more from the lake; at the foot of this passage the stream expands into a shallow muddy dead water about 40 feet wide, more or less, according to height of water. Below this the river was not examined. On July 22 the water was very low with no current below the race. Temperature, 77° on July 27. The water was dirty, warm, and sluggish. In October the current was swift in the "race" and full of fine débris of various kinds.

NATIVE FISHES.

The fishes inhabiting Sunapee Lake and tributary waters prior to the fish cultural introductions, which began in 1867, so far as records thus far show, comprised an even dozen species. These are: Horn pout (*Ameiurus nebulosus*); sucker (*Catostomus commersonii*); chub (*Semotilus bullaris*); blackspot chub (*Semotilus atromaculatus*); redfin (*Notropis cornutus*); black-nose dace (*Rhinichthys atronasus*); "native trout" (*Salvelinus fontinalis*); "white trout" (*Salvelinus aureolus* [a]); eel (*Anguilla rostrata*); pickerel (*Esox reticulatus*); sunfish or "pumpkin seed" (*Lepomis auritus* [b]); perch (*Perca flavescens*).

Of these, in the lake itself, only the horn pout, sucker, white trout, and sunfish seem to be at all common. In the brooks the trout and

[a] For reasons set forth in this paper in connection with this species, it is assumed that it is native to the lake.

[b] It is probable that another species (*Lepomis gibbosus*) occurs in some ponds connected with the lake, and the writer has been informed that it has been found in the lake; but in his observations, covering two seasons, he has seen none. There are published statements that the little fresh-water sculpin or "miller's thumb" (probably *Cottus gracilis*) was once common. It appears to be extinct now, or if present it is so scarce that none was observed in two seasons.

black-nose dace are quite plentiful, but the presence of the former is due mainly to fish culture. There seems to be a great scarcity of the cyprinid fishes.

The pickerel is present in some numbers, but can not be called common. In Forest and Stream of March 18, 1886, Dr. J. D. Quackenbos states that in Sunapee Lake all fish excepting the pickerel attain an unusual weight: "Yellow perch, 2 pounds and upward; landlocked salmon, 12 pounds (seven years from the ovum); brook trout, 6 to 9 pounds; black bass, the unprecedented weight of 7½ pounds (2 pounds beyond the limit of the naturalist)."

The scarcity of pickerel and other fishes may be due to a number of causes, such as unseasonable and over fishing, abundance of enemies, epidemics, scarcity of food, etc. Scarcity of food acts in two ways, i. e., death from starvation and cannibalism. The small size of pickerel or any other fish may be due to the same causes. Excessive and unseasonable fishing, especially ice fishing, removes the large fish, and without sufficient food no fish will attain a large size. The habits of the pickerel are such that they seldom take the fish into deep water where the smelts occur.

The black bass and landlocked salmon were introduced fish, and Dr. Quackenbos's statement was made a long time after the introduction of smelts. The trout and perch are fish whose habits would take them where the smelts resort throughout the year. The large size of these fish, as well as of the salmon, can very well be ascribed to the smelt, and the cyprinids, which were doubtless once more common. The black bass has been diminishing in size for a number of years, probably owing to the disappearance of its once more plentiful cyprinid food. That the pickerel did not and does not attain a large size is doubtless due to the same thing.

INTRODUCED FISHES.

With the characteristic zeal and enthusiasm of the early fish culturists, the commissioners of New Hampshire began introducing into various waters of the State all kinds of food and game fishes that could be secured. Sunapee Lake was one of the first to receive attention of this kind, and, in the light of our present knowledge, it is possibly a question whether this indiscriminate introduction of alien species into waters whose original forms were all that could be desired in food and game qualities was not a mistake. It was and still is often done at the urgent request or instigation of some influential person or persons who have a commendable desire to improve the declining fishing but lack knowledge of the habits of the species proposed to be introduced and, consequently, of the possible results of the introduction. It has been, and still is, often the result that the remedy merely augmented the disease and the conditions became worse than before.

The writer is inclined to believe that where the trouble consists of diminishing numbers of native forms, the cause should be sought, as in the practice of medicine, and the malady treated accordingly. If a patient is suffering from loss of blood it is not wise to remove more blood or administer blood-destroying drugs.

In the case of Sunapee Lake the fishing was on the decline and the main cause, in time at least, became apparent, i. e., too much or unseasonable fishing. A very potent method of exterminating trout is by fishing through the ice, but that method becomes practically innocuous compared with the practice of taking trout from their spawning grounds, and history tells us that both of these practices were not only indulged in but abused in highest degree 40 years ago and even later.

The "native trout" once abounded in Sunapee Lake and attained a large size. But while little fishing was done in the spring and summer, it was a practice, not only of the inhabitants of the immediate shores but of those from distant towns, to repair to the brooks frequented by trout in the fall for spawning, and with dip nets and spears to catch the fish in great numbers.

Fishing through the ice was also done constantly. It is the habit of trout to congregate during the winter in certain places affording them the proper winter conditions. The inhabitants in years gone by found these places and the knowledge was handed down from parents to children. Naturally it did not take many generations to "bleed" the lake very seriously.

The cause being known, the remedy lay in combatting it and in the "infusion of new blood;" in other words, in prohibiting destructive methods of fishing and in propagating the trout. This was finally attempted, but while the trout was continuously propagated to some extent, nonindigenous fishes were introduced now and then up to the present time, practically offsetting the benefit.

The possible injurious effects of the introduction of nonindigenous fishes into a body of water may be brought about in at least two ways: First and chiefly, through the destruction of the native fishes by the introduced voracious forms, and second, but still important, the diminution of the food supply of the native forms by introduced species.

The first-mentioned factor was undoubtedly, years ago, to some extent at least, active in Sunapee Lake through the introduction of landlocked salmon, and, according to some statements, possibly by black bass. If the black bass is absolved of that stigma it certainly may be indicted on the second count.

The danger to the food supply of the fishes, however, was lessened by the wise introduction of smelt, which was the third species of nonnative fish to be introduced. But this is claimed to have been detri-

mental to the fishing, many anglers averring that smelts afford such an abundant food supply that the game fish will not bite so readily and that the fly fishing has been ruined thereby.

The following is a list of the nonindigenous fishes in the order of the dates of first introduction:

Landlocked salmon, 1867.
Black bass, 1868.
Smelt, 1870.
Whitefish, 1871.
Wall-eyed pike, 1876.
Blueback trout, 1878.
Round whitefish, 1881 (?)
Loch Leven trout, 1888–9.
Brown trout, 1888–9 (?)
Rainbow trout, 1888–9.
Chinook salmon, 1904.
Grayling, 1906.
Silver salmon, 1909.
Lake trout (?) [a]

Of these the whitefish,[b] wall-eyed pike, blueback trout,[c] Loch Leven trout,[d] rainbow trout, silver salmon, and grayling have never been reported.

Omitting those which have not been authentically recorded, the list of species inhabiting Sunapee Lake in greater or lesser numbers will comprise 16, as follows: Hornpout, sucker, chub, blackspot chub, redfin, blacknose dace, chinook salmon, landlocked salmon, brown or Loch Leven trout, common trout, white trout, eel, pickerel, sunfish, black bass, perch. The status of each of these will be discussed under their respective headings.

There are various reasons why some of introduced species have never again been observed. The water may be unsuited to them, being too cold or too warm; there may be too many enemies, and the newcomers may have been all devoured by predaceous fishes; if they survive they may escape detection for a long time, or they may so closely resemble known species that they may not be recognized when caught. The latter is a very common occurrence, as evinced by the fact that when one of these forms has at last been recognized there were always those who remember to have caught one or more and to have thought them only variations of some known species.

THE ENTIRE FISH FAUNA.

Hornpout (*Ameiurus nebulosus*).

The hornpout is the only representative of the catfish family in New England, where it seldom attains a weight of over a pound. In Sunapee Lake it is said to be fairly common, and it seems to be indigenous.

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[a] There is no record of the introduction of this species, but some have been caught. Its occurrence is probably accidental, the young having become mixed with some other young salmonids.

[b] There are some vague traditions of whitefish having been taken in the lakes, but apparently none is there now. They could possibly be there and not be detected, but, by the methods of still fishing as practiced by the summer fishermen, if present, an occasional whitefish would probably be taken.

[c] Assuming that the white trout is an indigenous species and not the result of the plants of bluebacks. This question is discussed in another place in this report.

[d] "Loch Leven trout" of large size have been reported, but photograph and descriptions indicate that the supposed Loch Leven trout were brown trout.

It is occasionally caught by anglers while fishing for other fish in shallow water.

The favorite habitat of this fish being in shallow, muddy waters, and it being only very occasionally found elsewhere, there is no likelihood that it does much, if any, direct harm to the more desirable fishes, although it is almost omnivorous. The fish most liable to the attacks of the marauding hornpouts is the black bass when spawning in the shallow water, but even then the bass probably can take care of its nest to a great extent.

The only examples of this fish observed in the study of the lake were: On August 17, 1910, one about 10 inches long was caught off Cressy Point, and on August 17, 1911, the writer found in a "swash pool" near the mouth of Pike Brook eight young about $1\frac{1}{8}$ inches long, and some smaller ones were taken in a fyke net in Pike Brook near the mouth at the inner or dead-water edge of the beach.

SUCKER (*Catostomus commersonii*).

The sucker is very common and attains a large size in Sunapee Lake. When the water is sufficiently high in the spring to allow the suckers to get into the brooks, they run in in considerable numbers to spawn, and at that time many are speared by the residents, who esteem them highly as food. The run is usually from the last part of April to some time in May. In 1910 a very few suckers ascended Pike Brook. Nothing was learned regarding their presence in other brooks. The first to appear in Pike Brook were 3 males, $12\frac{1}{4}$, 16, and $17\frac{1}{4}$ inches long, respectively, which were speared on the night of April 16. Only one was quite ripe. No more were seen in April, but there was a small run reported in May.

The sucker deposits a large number of eggs and in the comparatively safe spawning beds many hatch and the young gradually work down into the dead waters, where some of them linger all summer and perhaps longer. On October 23, 1910, two suckers, respectively 12 and 14 inches long, were found in a pool in the beach at the mouth of Pike Brook. Their color was dark and brassy, indicating that they had probably come down from the dead water, and on November 3 a number from 5 to 14 inches long were taken with small trout that were descending from the brook into the lake. Some, however, while still quite young, enter the lake and occur in small schools along the shallow waters of the sandy beaches, and some may be hatched in the lake.

In April, 1910, the young suckers observed in Pike Brook averaged about 3 inches in length. In the same brook and in Blodgetts Brook in August the fish ranged from $1\frac{1}{4}$ to 2 inches long. But about the middle of August a lot of only $\frac{3}{4}$ to $1\frac{1}{8}$ inches long were found in a pool in the beach left by the receding lake water. A small fyke net set at

the dead-water end of Pike Brook channel through the beach, about the same time, took a considerable number, many from $1\frac{1}{2}$ to 2 inches long, with some about 4 inches, which apparently had started for the lake.

Other fishes, such as black bass, perch, and pickerel, feed upon the young suckers, but the adult sucker is, on the other hand, very destructive to the eggs of other fishes, especially such as spawn in the lake. Suckers are always present on the spawning ground of the white trout in the fall and are taken in gill nets set for this trout by the fish culturists in spawning time. Some ranging from 6 to 17 inches were taken in the gill nets set for trout in shallow water near the mouth of Pike Brook.

CHUB (*Semotilus bullaris*).

The chub, here as in many other places known locally as dace, is the largest native species of the minnow family in eastern North America, in some waters attaining a weight of 2 or 3 pounds or more. It is also one of the commonest fishes of the Eastern States, but does not seem to be abundant in Sunapee Lake. Chubs were frequently taken in the gill nets set for white trout and salmon during October and November. The only adult individuals observed were some 12 and 13 inches long taken at that time, excepting one on August 18 that had been caught by some men fishing at "the banks." It was about 1 foot long and had red fins, which the men were using for bass bait.

Small chubs, in common with other small fishes of the family, are known as shiners and are esteemed as live bait. These occur in the brooks and were especially abundant in Pike Brook dead water. On August 18, 1910, a good many $2\frac{1}{4}$ to $2\frac{3}{4}$ inches long were taken with caddis larva bait at the lower end of the dead water.

Now and then one was seen farther up the brook, even in quick water, and one about 2 inches long was observed in the cool spring pool near the hatchery, but they seem generally to affect the warmer waters. It is not known that the young chub leaves the brooks and dead waters at any particular time or under any special conditions, but on August 17 and 18, 1911, a few 3 and 4 inches long were taken with other small fishes at the dead water end of Pike Brook channel through the beach, which indicated that they were possibly attempting to go to the lake.

Although the chub has toothless jaws and tongue, it is carnivorous, subsisting upon insects and other fishes to a large extent. The writer has seen chubs feeding upon and has found them gorged with young pickerel 3 and 4 inches long. While the chub is more or less destructive to other fishes and is, like the sucker, a spawn eater, it is too scarce now in Sunapee Lake to cause any alarm.

FIG. 1.—MOUTH OF BLODGETT BROOK IN AUGUST. DEADWATER JUST BELOW BRIDGE.

FIG. 2.—A CHUB'S NEST. PARTLY EXPOSED BY SUBSIDING WATERS.

(Photograph by courtesy of Dr. Alfred T. Wilson.)

The chub is very interesting in the curious habit of the male in breeding season of heaping up pebbles, which it conveys in its mouth to the spot chosen for the "nest" in which the female deposits her eggs. During the building usually no other fish is permitted to approach the nest, although in occasional instances one or more other males assist in the work of construction. The heap is often of remarkable size, especially in the waters of the far north, a cartload of pebbles composing it. The nests observed at Sunapee Lake were comparatively small, but the water having subsided they became quite conspicuous. On August 9, 1910, in the north branch of Blodgett Brook ("Big Brook") was found a chub's nest about 4 feet in diameter, but only a few inches high. Some of the pebbles composing it would weigh perhaps one-fourth of a pound, the coarser ones being on the upstream side, owing, doubtless, to a strong current when the nest was built or afterwards. In fact the current may have demolished the nest, which hypothesis would account for the wide area and lowness of the heap. There were other smaller and higher nests farther down the brook, one of them under the bridge. They were all dry at this time. On August 18 a chub's nest fully 5 feet in diameter and 1 foot high was found at the upper end of Pike Brook dead water.

Blackspot Chub (*Semotilus atromaculatus*).

This chub is known in the Connecticut Lakes region as "mud chub." It does not reach the size of the common chub, seldom, if ever, attaining more than 10 inches in length, and usually it is much smaller.

It is much darker in coloration than the chub and may otherwise be distinguished from it by the black spot near the base of the front of the dorsal fin. Owing to its darker color it is not so useful as bait as is the common chub. It subsists largely upon aquatic larvæ of insects, insects that have fallen upon the water, and occasionally young fish.

This chub is evidently not very common in Sunapee Lake or its tributaries, at least near the lake. The only specimen observed by the writer was collected in Pike Brook with smelts on the night of April 23, 1910. It was about 6 inches long.

The blackspot chub also builds "nests" of pebbles, but the heaps are much smaller than those of the common chub. On August 18, at the upper end of Pike Brook dead water, was found a small heap of little pebbles, very probably the nest of this species. The heap was about 8 inches in diameter.

Redfin (*Notropis cornutus*).

The redfin, also known as redfin shiner and just shiner, reaches a length of 5 or 6 inches, but usually is not over 3 or 4 inches in length. The color of the pectoral fins and margins of the dorsal and anal of the male in breeding season gives it the name of "redfin," and it is a most beautiful fish at this season, reflecting all the hues of the rainbow. The red of the fins, however, often persists long after the breeding season. This fish is one of the most highly esteemed live baits, but, like other cyprinids, seems not to be common in Sunapee Lake.

The vertically elongated exposed portion of the scales of the body forward serve to distinguish this fish from all others of the family in New Hampshire.

The breeding season of the redfin is in the spring or early summer. The precise time of its breeding in Sunapee Lake was not ascertained, but on April 16, 1910, a number about 3 inches long, two of them with red fins, were taken in Pike Brook. The species seems to be common in Pike Brook dead water throughout the summer. On August 19, 1910, several specimens 3½ to 4 inches long were caught at the upper end of the dead water on caddis larva bait, and on August 19, 1911, several about 3 inches long were taken in the fyke net at the dead-water end of the channel through the beach.

Blacknose Dace (*Rhinichthys atronasus*).

This is the smallest species of the minnow family found in this region. It is not commonly seen in the lake, but in brooks it is apparently abundant. It is easily recognized by the very fine, scarcely discernible scales and the intensely black stripe extending from the snout to base of the tail. It attains only 4 or 5 inches in length, and most of the individuals observed are somewhat smaller. It also is a good bait.

It subsists mainly upon the aquatic larvæ of insects and small insects that fall upon the water. It affords food for trout to some extent, but in the brooks it occupies the warmer portions in summer, where the trout are not at that time found.

Many from 1½ to 3 inches long were observed in Pike Brook on April 15, 1910, and on July 19 and August 15 many were seen in the same brook in the lower meadow.

Pickerel (*Esox reticulatus*).

The pickerel is the only member of the pike family indigenous to New Hampshire waters. It is a well-known fish, by some highly esteemed, much maligned by others, being accused of all sorts of piscivorous atrocities. There is scarcely a body of water in which trout

once lived and where pickerel now occurs that the depletion of the trout has not been ascribed to the pickerel. It undoubtedly eats other fishes, and there are few fishes that do not. But the habits of the pickerel are such that it is not nearly so detrimental to other fish life as some other species held in higher regard, and the pickerel in large bodies of water becomes still less harmful. It is not much of a wanderer. It does not rush about in marauding bands seeking what it may devour. It lies in wait and grabs what comes its way when it is inclined to feed, yet often schools of tempting shiners have been seen swimming unharmed in apparently dangerous proximity to big pickerels' heads. Pickerel feeding will take any moving object within reach, young of their own kind not excepted. Young pickerel from $2\frac{1}{2}$ to 3 or 4 inches long at Sunapee Lake were found subsisting almost wholly upon the aquatic larvæ of insects that occur so abundantly in the still or dead waters of the brooks.

While usually inhabiting the shallow, weedy coves and bays in the warmer months, large pickerel are often found about rocky shores and in deeper water. In winter, too, they congregate in deeper water, and it is owing to this fact that fishing through the ice so often depletes a lake or pond of pickerel.

The habit of pickerel of seeking shallow, weedy places is one which ordinarily makes for the safety of the deeper and cooler water denizens, but in some lakes, Sunapee, for instance, it becomes to some extent a disadvantage. Such congenial pickerel haunts are the dead waters at the mouths of inflowing streams, which streams are often natural trout nurseries and are frequently used in planting trout and salmon. When the trout and salmon descend toward the lake they often have to run the gauntlet of the waiting maws of the pickerel and doubtless many have been destroyed in that way.

The pickerel probably spawns in the dead waters of the brooks when possible, and the young remain in shallow water until they are of considerable size. While they are most frequently found in the shallowest waters and even some distance up the brooks, they probably seek these places mainly for self protection from other larger and voracious fishes rather than for food, which is more abundant in the still or dead waters. During 1910 and 1911 some young pickerel were seen throughout the season in Pike Brook dead water. In August the young were from $2\frac{3}{8}$ to $3\frac{1}{4}$ inches long and all at the upper end of the dead water or in a pool a short distance above the dead water.

The smallest pickerel observed in the lake were two, each about 10 inches long, seen at Newberry in shallow water on rocky bottom, October 18. Other pickerel observed were one of about 2 pounds caught by trolling in July near Blodgetts Landing and several in October and November, 13 to 16 inches long, taken in gill nets near the mouth of Pike Brook. A 13-inch fish caught near the mouth of Pike

Brook bore marks as though a mink had bitten it. Its stomach contained the tail end, including the anal fin, of a half digested sucker. Judging from the fragment, the sucker must have been about 6 inches long.

The pickerel, however, while once quite abundant, is now comparatively scarce, and therefore is almost a negligible factor in trout and salmon destruction in Sunapee Lake. The reasons for this are those that obtain in the cases of scarcity of fish of any kind in any fresh waters. The waters are not especially suited to pickerel. There has been an increase in numbers of some of its existing enemies, there has been a reenforcement of others, and the lake has been excessively fished at times particularly advantageous to such fishing.

Eel (*Anguilla rostrata*).

The common eel does not seem to be very common in Sunapee Lake. It is so rarely taken by fishermen that but few know that it occurs there. It probably can now with great difficulty, if at all, gain access to the lake. The only one observed by the writer was caught on a "set line" with smelt bait at Curtis's pier, April, 1910. It was 28½ inches long. The stomach contained a lot of fine, brown, mud-like substance, the nature of which could not be determined.

The eel is very destructive to fish, especially small ones, and fish eggs. It attacks and attaches itself to spawning fish caught in gill nets and burrows into the body, eating the ovaries and eggs. It is fortunately so scarce that it need not be feared for the damage that it otherwise might do.

Whitefish (*Coregonus clupeaformis*).

The State report for 1871 says that 120,000 whitefish were hatched from eggs obtained at Missisquoi Bay, Lake Champlain, and planted in "Winnepiseogee" and Sunapee Lakes. The report for 1872 says that some 50,000 or 60,000 were hatched and the young divided between Winnipesaukee and Sunapee Lakes, and in 1873 it is reported that 150,000 were hatched and planted in the same lakes.

The whitefish has not been recognized in Sunapee, and it is doubtful whether it occurs there, although it might escape notice for many years. It was not until about 1901 that it was discovered to exist in Sebago Lake, Me., where it seems as though it must be indigenous, as there are no records of its ever having been introduced. Since its discovery there a good many specimens have been taken and recognized. It is a somewhat laterally compressed fish with very small, toothless, and tender mouth parts. It is the same fish that is indigenous to Lake Winnipesaukee, where it is known as "whiting." In

some waters it attains a weight of 10 pounds or more. The majority, however, as caught, are much smaller.

It occasionally takes the hook baited with small fish, and sometimes rises with avidity to the artificial fly. It is an excellent food fish and one usually commanding a high price in the market.

The native whitefish of Maine and New Hampshire, whenever possible, ascend streams to spawn, in the last of October and in November, but the Great Lakes whitefish are not known to do this, perhaps because of the absence of suitable streams, or perhaps they have not been reported.

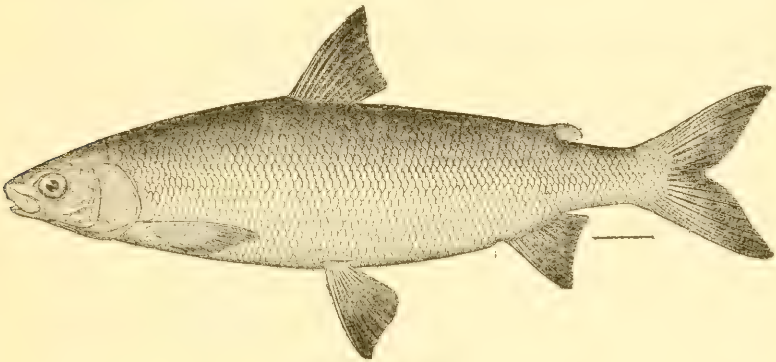

FIG. 1.—Whitefish.

The whitefish varies its diet considerably, its food consisting of insect larvæ, insects, and small fish such as young smelts, and, when obtainable, Crustacea and mollusks.

ROUND WHITEFISH (*Coregonus quadrilateralis*).

This fish occurs in many of the larger and deeper lakes of New England, northern New York, the Great Lakes, and to Alaska, Labrador, and the Arctic Circle. It attains a weight of 2 pounds or more, but usually is considerably smaller. Its principal food seems to consist of insects, insect larvæ occurring in the water, minute Crustacea, etc. It occasionally takes a baited hook and sometimes an artificial fly. In most New England waters, when possible, it ascends streams in the last of October and early November to spawn, at which time the males are covered with small pearly excrescences or so-called breeding tubercles (as is the case with nearly all of the species of whitefish), the significance of which is not positively known, but possibly by the male rubbing against the female they excite her to extrude her eggs.

It is a very good food fish but inferior to the preceding species. No advantage would be gained through its successful introduction into Sunapee Lake except by affording food for other fishes, unless net fishing were allowed, as it so seldom can be taken in any other way.

The round whitefish may be distinguished from the common whitefish by its more cylindrical or spindle-shaped form, smaller mouth, compressed and sharper snout, and more numerous scales. In the Connecticut Lakes it is known as "billfish."

In the Report of the Fish and Game Commissioners of New Hampshire, 1881, page 21, the following paragraph appears:

WINNEPESAUKEE WHITEFISH, OR "SHAD-WAITER."

This delicious fish is little known in the State, except to the inhabitants of the towns bordering on Lake Winnepesaukee, but is really one of the most valuable food fishes we have.

It is a local variety of the celebrated whitefish of the Great Lakes, and is unsurpassed in its qualities as a table fish. It belongs to the same great family of Salmonidæ, and is now classed by Profs. Jordan and Milner as *Prosopium quadrilateralis*. We took at Weirs Village, last November, 60,000 eggs of this fish, one-half of which were sent to Massachusetts, and the remainder will be placed in Sunapee Lake. We believe that the propagation of this variety of fish should be followed up in future, and one or more of our largest lakes stocked annually with from 20,000 to 30,000 young fry. All experience goes to show that the larger the plant made the more likely it is to be successful.

No further mention is made of planting the fish in Sunapee Lake. While according to Dr. Prescott,[a] this fish, which he describes as new under the name of *Coregonus Nov-Angliæ*, is called "shad-waiter" at Winnepesaukee, and the common whitefish, which he also describes as new under the name of *Coregonus Neo-Hantoniensis*, is called "the whiting," there is some doubt whether this species and not the common whitefish is meant in the preceding quotation from the commissioners' report, since it is there stated that "it is a local variety of the celebrated whitefish of the Great Lakes."

Chinook Salmon (*Oncorhynchus tschawytscha*).

The chinook salmon is an inhabitant of Pacific waters, its geographical range extending from Alaska to the Ventura River in California, and northern China on the Asiatic coast. It is the salmon that made Columbia River famous and is by far the most valuable of its tribe. It attains the largest size of the five species belonging to the genus *Oncorhynchus* (hook-nose), individuals weighing over 100 pounds having been reported. It does not, however, average much, if any, over 20 pounds.

Habits.—Like other salmon, much of its life is spent in the sea, whence to breed it ascends fresh-water rivers, when possible to their utmost sources, sometimes more than 1,000 miles from the sea. The time of its runs and the spawning time varies in different rivers. In southern rivers there are spring runs and summer spawning, and later runs with fall spawning. The early runs ascend farthest up the river.

[a] Descriptions of new species of fishes, from "Synopsis of the Fishes of the Winnipesseogee and its Connecting Waters," Am. Jour. Sci. and Arts, 1851, p. 342, by William Prescott, M. D., of Concord, N. H.

Farther north the runs are not so distinct and the spawning times not so widely separated. In Alaska, for instance, while there are indications of distinct runs, the process is practically continuous.

The young salmon are said to go to sea as soon as they can swim and eat. Their parents, like all other salmon of the genus *Oncorhynchus*, soon die, the species spawning but once in a lifetime. This is not a recently discovered, though a comparatively lately verified, fact. In Arctic Zoology, published in 1784, Pennant, deriving his information from an earlier work on Kamchatka, says:

> Every species of salmon dies in the same river or lake in which it is born, and to which it returns to spawn. In the third year male and female consort together and the latter deposits its spawn in a hole formed with its tail and fins in the sand, after which both sexes pine away and cease to live.

Pennant, however, evidently ascribes this phenomenon to starvation and attendant weakness and the consequent inability to reach the feeding grounds, and not to a decrée of nature.

Young salmon subsist mainly upon insects.

It has been positively ascertained that in the sea the chinook does not, always at least, depart far from the coast, and that while in the sea and estuaries it feeds upon small fish such as herring, smelt, anchovies, etc., and its movements in the sea are doubtless to a great extent governed by its food supply. It is, however, apparently a rather indiscriminate feeder, taking not only almost any small fish, especially those that swim in schools, but free-swimming marine invertebrates, such as squid, shrimp, etc. Its voracity is graphically illustrated by J. Parker Whitney in an article descriptive of angling for chinook, in Monterey and Santa Cruz Bays, Cal., which appeared in Forest and Stream a number of years ago. He says:

> As I fought my salmon to gaff, my sinker was caught by another salmon as I was lifting it clear from the water to detach as usual from the boat side, and carried it off. This was within 6 feet of the boat and I plainly saw the rush, the open mouth, the strike, and the tear away. The sinker line fortunately broke, leaving my half-exhausted salmon on my hook line, which I afterwards safely brought in. Striking at the sinker is by no means rare with the salmon; this was the third I had had carried away. I have several times seen the salmon strike the sinker within 6 or 10 feet of the boat and strike at it several times in succession.
>
> There was no difficulty in following the school, although the later ruffled water made the break less conspicuous. The friendly shags, murrs, and gulls came for their harvest also, following up the salmon breaks for the demoralized anchovies.
>
> On the combing beach went the anchovies, the salmon, and birds, and more slowly my boat, impeded by the necessity of fighting the hooked salmon. But we followed on, finally into the jaws of the ground swell, where for half a mile in length on the sand beach the salmon held the anchovies for at least two hours. Many of the anchovies were driven upon the sand.

Acclimatization in eastern waters.—Attempts have been made to acclimate the chinook in many eastern waters. The earlier plants were made under the name of California salmon, later under the names of quinnat salmon and Pacific salmon. The latter, however, is not specific, there being four other species of this genus in Pacific

waters. The best-known and appropriate names in the United States and Alaska are chinook salmon and king salmon, although it has several others of somewhat restricted local use.

This salmon has been planted in eastern waters, off and on, since 1873, and some placed in fresh-water lakes. The results of these plants have not been very encouraging, the most successful outcome being in Sunapee Lake.

The records of the capture of this species in any waters since its introduction are very meager. From those planted every year from 1874 to 1879 in Lake Michigan waters only two have been reported; June, 1879, one measuring over 20 inches in length, caught in Lake Michigan, and in November of the same year another measuring 10 inches in length, caught in Green Bay, Mich., were sent to the United States National Museum. From the report of the Fish Commissioners of New Hampshire for 1881, the following extracts are reprinted from an article by N. K. Fairbanks, entitled "Breeding California salmon in fresh water," referring to the results of introduction of the chinook into Geneva Lake, Wis.:

> Having all the requisites which I consider essential to the experiment, viz, pure deep water, a moderately sized lake, with room for range and exercise and plenty of food, I began in the spring of 1876 by depositing 25,000 California salmon which were hatched at the United States hatchery at Northville, Mich., by Frank N. Clark, and were sent to me by Prof. Baird, United States Fish Commissioner. The Wisconsin commission also put in about 15,000 shortly after.
>
> In April, 1877, I also procured from Prof. Baird about 25,000 and from the Wisconsin commission 25,000, and in the fall of 1877 I received from the United States commission 100,000 eggs from the McCloud River, which I hatched and put into the lake in the spring of 1878. I also deposited 200,000 in the spring of 1879, 100,000 last April, and 100,000 yearlings last October, making in all in round numbers 590,000, hatching count; deducting for losses from various causes, I estimate that I have placed in Geneva Lake half a million young California salmon in excellent condition.
>
> They began to make their appearance and attain considerable size very soon, and during the summer of 1878 there was an occasional one caught by parties who were fishing for bass. I had four sent me one day which weighed three-quarters of a pound each, and one of them went a trifle over a pound. In the summer of 1879, Mr. L. Z. Leiter, while trolling for bass, captured a very fine salmon which weighed 4½ pounds. Several others were taken during the summer, weighing 2 to 3 pounds each, all of which was reasonably encouraging; but not until the developments of the past summer have I felt that the experiment would prove a valuable one, when, on the afternoon of July 29 last, I was presented with a beautiful specimen which was 29½ inches long and 18 inches girth and weighed 12¾ pounds, and when I had it boiled and served for dinner and found it to be a delicious fish, then I felt certain that the salmon would grow to a respectable size and condition in fresh water, and that at least, so far as that fish and my dinner of that day went, it was no longer an unsuccessful experiment—there was a reality, the "substance of things hoped for," which did much to strengthen and build up my faith.
>
> In September they began to show themselves at the head of the lake near the mouth of a small creek having its source in a group of springs a mile back, which empties into the lake. Mr. William Welsher, who has charge of the hatchery and ponds there, discovered eight fine specimens one day splashing about in this creek. They were up the creek nearly a mile, and as far as they could get and were, of course, looking

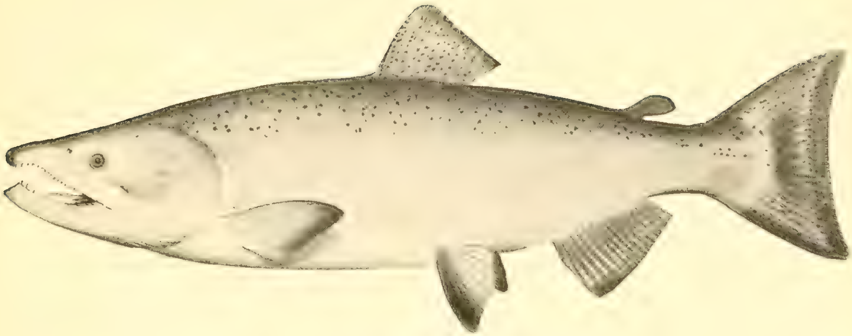

FIG. 1.—CHINOOK SALMON. BREEDING MALE.

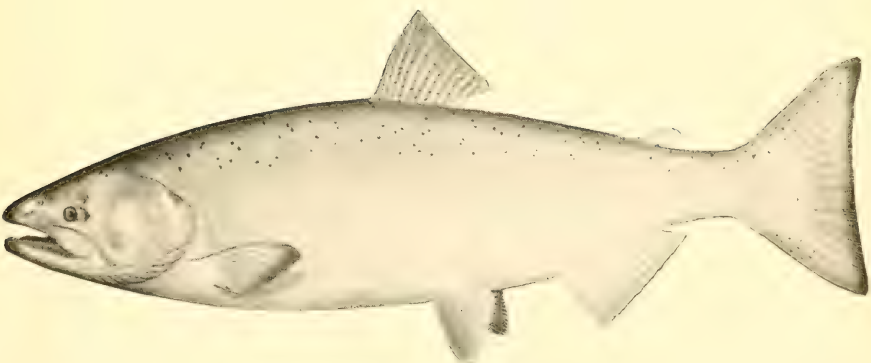

FIG. 2.—CHINOOK SALMON. BREEDING FEMALE.

for a spawning bed. The following day he captured a fine female in the creek, which was full of eggs and quite ripe. Those which he saw in the creek he estimated would weigh 8 to 10 pounds each. The one he caught weighed $8\frac{1}{2}$ pounds, and one which he found up the creek a week later in shallow water, and which he picked up and threw into deep water, he estimated would weigh 10 pounds. He informed me that a month ago he saw a pair much larger than before mentioned, at the mouth of the creek, but they could not get over the little bar formed at the mouth. He estimated this pair would weigh 20 pounds each, and that the female might go up to 25 pounds. He also saw very decided indications of spawning nests in the gravel about the mouth of the creek, all of which facts satisfy me that the salmon will not only attain a large size but will also breed in fresh water. Unlike Brigham Young, they find they can be very good Mormons and increase and multiply without going to a salt lake.

Salmon were planted in Lake Ontario waters in 1879 and again in 1897 and 1898, but only one was ever reported. This fish, a ripe female, weighing 14 pounds, caught September 1, 1900, was sent by Livingston Stone from Cape Vincent to the United States Fish Commission.

No more were reported from anywhere until 1903, when the State Fish Commissioner of Maine wrote to the United States Fish Commissioner that quinnat salmon, some of which weighed as high as 16 pounds, were being caught in Pierce Pond, an affluent of the Kennebec River, in Somerset County, Me. An investigation of the subject revealed that the large fish supposed to be chinooks were landlocked salmon. Two years later, however, small fish of 1 or $1\frac{1}{2}$ pounds in weight, stated to have been caught in Pierce Pond, were sent to the Academy of Sciences of Philadelphia and United States National Museum, and proved to be chinooks, but they were the result of plants subsequent to the one supposed to have been the origin of the alleged "quinnats" of 1903.

The first of this species to be planted in Sunapee Lake were 3,000 fingerlings hatched at the Laconia station in 1904. Though there are no definite records between 1904 and 1908, it has been stated that some fry have been planted every year since, and in the State commissioners' report for 1907 and 1908 it is stated that the commissioners for the last four years have planted fingerlings and yearlings of the Pacific salmon. There is also the indefinite record of 12,000 "salmon" fingerlings planted in Sunapee Lake in 1907. In the United States Bureau of Fisheries report for 1904 it is recorded that 100,000 eggs were sent to the Laconia station, and there are consecutive records from 1908 to 1910, inclusive, while the writer has been able to secure from the Division of Fish Culture, Bureau of Fisheries, a statement of the number planted in 1911. The published records and this statement show the following plants: 1904, 3,000 fingerlings; 1908, 40,000 fingerlings; 1909, 38,070 fingerlings; 1910, 51,200 fingerlings; 1911, 24,370 fingerlings and fry; total, 156,640.

Records of chinook salmon caught in Sunapee Lake.—The following records are far from complete, but they represent all the positively

identified salmon that have been reported. George H. Graham, secretary of the Sunapee Lake Fishing Association, states[a] that during 1908 a few of these salmon were taken weighing from 2 to 4 pounds, during 1909 over 200 were taken, some weighing 8 pounds, and during 1910 from 400 to 500 were taken, some as large as 17 pounds. One angler, according to Mr. Graham, caught nine salmon that weighed 80 pounds, the largest two weighing 13½ pounds each. The banner year was 1910, the catch of 1911 falling far short of the catch of that year.

It can not be positively affirmed that all the fish reported as such were chinooks, but it is sure that the majority were, inasmuch as most of the anglers had learned to distinguish this species from the landlocked salmon. It is possible, however, that some "landlocked" were pronounced chinooks, and that possibly silver salmon may have been mistaken for chinooks, being more difficult to distinguish.

Data Regarding Chinooks Caught in Sunapee Lake, as Afforded by all Available Records Prior to 1910.

Date of capture.	Size.	Sex.	Remarks.
Aug. 28, 1906	5¾ pounds		First reported.
Apr. 28, 1908	24½ inches long	Male	Ripe.
August, 1908	11½ inches long		
Apr. 30, 1909	10 pounds		
May, 1909	15 inches long		
Aug. 14, 1909	5 pounds		
Nov. 8 to 12, 1909.		4 males and 1 female.	Taken by Bureau of Fisheries party. The female was immature but probably would have matured in 1910. An unsuccessful attempt was made to fertilize landlocked salmon eggs with chinook milt.

Date of Capture and Weight of 31 Chinook Salmon Brought into Blodgetts Landing and 15 Brought into Newbury in 1910.

Date.	Weight.	Date.	Weight.
BLODGETTS LANDING.	Pounds.	BLODGETTS LANDING—continued.	Pounds.
Apr. 22	9	June 28	8
24	8	30	10½
27	7	July 10	4
May 4	5	12	5
4	5	13	8¼
5	7½	25	10½
8	7½	26	7½
8	6½		
8	4	NEWBURY.	
24	8	Apr. 17	2¾
27	8	17	4$\frac{1}{16}$
28	7	17	4$\frac{5}{16}$
29	8	17	2$\frac{1}{16}$
30	6	17	5$\frac{6}{16}$
June 4	3	17	4½
14	4½	24	6⅛
14	4½	May 4	3
14	4½	8	5½
14	4½	11	4¼
14	9	June 3	6⅛
14	4	(?)	16
14	6	Aug. 2	7½
21	9⅛	4	12
25	7¼	11	16⅜

[a] Recreation, Apr., 1911, p. 187.

The preceding table records 46 chinooks taken during the season of 1910, averaging about 6.5 pounds weight. While this number of fish by no means represents the number caught, it very approximately shows the probable average weight.

In 1911, on July 18, a 12-pound chinook, on the 24th a 15-pound one, on the 28th another of 14 pounds, and on the 30th a 14¾-pound fish were caught at Split Rock. The latter measured 31½ inches in length, a female with eggs about the size of BB shot.

On August 3, one of 13$\frac{1}{16}$ pounds was taken at The Hedgehog grounds.

On October 18 the Nashua fisheries station party took in a gill net set in about 3 feet of water a chinook which weighed 7 pounds when weighed two or three weeks after it was caught. It was found dead in the net. It was an immature female that would probably have spawned in 1912. The scales indicate about 3 years of age.

On the 19th one was taken in the same place, the length of which was 33 inches, depth 8½ inches, girth immediately in front of the dorsal 20 inches. It weighed 16 pounds after about one month in retaining car, and had probably weighed 2 or 3 pounds more when caught. It was a male with well-advanced but still firm spermaries, which would have ripened that fall, but which were perhaps retarded by confinement in the fish car. The scales indicated about 4 years of age.

On October 31 the same party took a small immature male, 14½ inches long, off Hays Point, on "The Reef." On November 11 a small one 15¾ inches long was caught in the nets set for white trout on "The Reef," apparently an immature female.

The results of the introduction of chinooks into Sunapee Lake show that the conditions are to some degree favorable to their existence. It may be said, however, that the fact that a few hundred have been caught in the last three years, and some of them of fairly large size, does not prove that the stocking of the lake with this fish has been a complete success. In such an application of the term, "complete success" should signify that the lake has been permanently stocked; in other words, that it has become self-sustaining.

For the stock to be self-sustaining the conditions for growth and reproduction must be favorable. The results thus far indicate only that the conditions of growth from fry or fingerlings to well-conditioned adult fish are very favorable, and one of these conditions is the abundance of suitable food. But, to know that other conditions are favorable it must be shown that the fish can mature and breed here. In other words, having reached maturity, the stock must have favorable natural conditions for spawning, or else it must be possible to take sufficient numbers in breeding condition to produce an annual supply of young to replace the fish that have succumbed to the mortal breeding function.

Observations made upon a few fish taken in Sunapee Lake and elsewhere show that some permanent fresh-water residents of this species do reach maturity, but suggest that they do not all mature at the same time. It is not only possible, but quite probable, that there may be no definite breeding season. This may be accounted for by the fact that in its natural habitat there are two, or even three, more or less distinct runs, according to locality, so that the spawning covers nearly all summer and fall; and to be considered with this is the change to environment lacking the normal stimuli. In other words, any approach to innate regularity in this respect may be disturbed by permanent residence in fresh water. The habits of this salmon in Pacific coast waters indicate almost, if not quite, conclusively that on the spawning beds must be quick-flowing water of certain degrees of temperature, such as are found in the highland sources and tributaries of the rivers ascended.

Tributary streams with sufficient volume of water to allow the ascent of salmon to suitable spawning beds are wanting at Sunapee Lake. While in the absence of such streams salmon reaching spawning condition might deposit their eggs on shoals along shore or in the lake, the chances of more than an inconsiderable number, if any, hatching and reaching adult size are very slight.

It therefore devolves upon the fish culturist to assist the fish in making the stock self-sustaining. In order that this may be done there must be, as previously mentioned, fish enough secured in the fall to supply the requisite number of fertilized eggs to produce an adequate return to the lake. The question then arises, What constitutes the requisite number and adequate return?

There is no way of even approximately ascertaining how large a plant of young is necessary to produce what might be considered good average fishing in the lake. The results of the plant of one year may be very different from those of another, and what constitutes good fishing for a few anglers might afford a very poor general average for the many in a season. The fishing season extends variably from about April 15 to September 15, or approximately five months. More salmon are caught during the first half of the season, however, than the latter half, and it seems fair to estimate 100 days as the average salmon-fishing season. The number of chinooks planted in 1904 may be regarded as a negligible quantity in the catch of fish in 1909 and 1910, and assuming that none was planted between 1904 and 1908 (there are no records of such plants), the plants contributing to the catch of 1909 and 1910 would be those of 1908 and 1909. In round numbers there were 78,000 fingerlings planted in those two years, and the estimated catches of 1909–10 amounted to between 500 and 650 fish.

It is not known to the writer how many anglers fish at Sunapee, but Mr. Graham states (op. cit.) that 10 anglers were fishing there in 1910 to 1 twenty years ago. In Forest and Stream of October 23, 1890, it is stated that "as many as 25 boats have been anchored in one string at Sunapee Lake." Allowing only one angler to a boat, there would be 25 fishermen on this one ground alone. A very low, or at least conservative, estimate, it would seem, would be 200 anglers on an average at Sunapee Lake each season at the present time. Setting the catch for 1909 and 1910 at 600 undoubted chinooks, this allows only 3 fish to each angler in two years' fishing, and unless a sufficient number of other species are caught to satisfy the anglers this must be considered a very poor return for the money invested. Again, 600 fish is less than four-fifths of 1 per cent of the number of young chinooks planted. But, of course, there is no way of ascertaining how many of those planted survived or how many are still in the lake. It is therefore possible that nearly all the survivors were caught, or that only a small per cent of them were taken.

The unsuccessful efforts in the fall of 1911 to catch chinooks in breeding condition indicate either that the fish were very scarce or else that they had not reached maturity. If the latter is the case the fall of 1912 ought to reveal their presence, being about the fifth year from the time of hatching. If few or none can be secured in 1912, it will indicate that probably the 1908 plant has practically ceased to exist. Breeding fish of the 1910 plant, if the fifth year is correctly set as the breeding time, will manifest itself one way or the other in 1913, and so on. The angling record of 1912 will also contribute to the data for predictions. As it is, the fact seems obvious that the number of chinooks planted has not been sufficient to afford what may be called even good fishing, and unless the stock of the lake will reproduce to that extent the introduction of this fish may be considered a failure, for enough have been planted to demonstrate whether or not the lake can be made self-sustaining, so far as this fish is concerned.

There are those who have thought that the chinook successfully acclimated in fresh water as a permanent resident might reverse the laws of nature and continue to live after spawning. If there were not sufficient other evidence to the contrary, such hopes would be blasted by the report of the experiences with this fish in the Trocadero Aquarium, Paris, France, by Eugene Juillerat. After discussing the merits of the fish, he writes:

By all of these qualities the *Salmo quinnat* recommends itself especially to the attention of fish culturists, and its culture would have been undertaken on a large scale if it were not for a serious drawback. After spawning in closed waters it always dies. For 20 years they have been cultivated at the Trocadero Aquarium, and never have I seen this fish live more than some months after the act of reproduction. So

certainly is this so that the symptoms which mark the approach of their spawning are also those of their death.

Such being the case, enough young must be planted every year to supply the demand of a constantly increasing number of anglers, as well as a sufficient number to insure breeders to furnish the supply.

The usual breeding age of chinooks on the west coast of the United States and at the Trocadero Aquarium is quite positively stated to be 4 years, although some, especially males, mature earlier than this and some are retarded somewhat longer. In Alaska it has been found that the usual breeding season occurs about the fifth year. It has in this report been previously suggested that if the Sunapee chinook has a regular breeding season it may occur in its fifth year. Therefore, if this is correct, a practically complete disappearance of each year's plant may be reckoned on by the end of the fifth year.

The more fish planted and surviving, the more will the anglers catch (unless there are enforced restrictions of the catches), and the number to be planted to produce the additional supply of breeders on that account must be increased and so on in an interminable progression. It is, therefore, as before remarked, obviously impossible to estimate even approximately how many need be planted to afford good average fishing and to insure breeders enough to maintain it. Even if the exact percentage of survivors of each plant could be known and the catch of each season could be regulated, it would be impossible to know that the required number of breeders could be secured even if present in the lake.

The foregoing facts indicate, to the writer's mind at least, that a permanent self-sustaining stock of chinook salmon in Sunapee Lake is unattainable.

The other game fish at Sunapee Lake at present offering any attractions to anglers are landlocked salmon, "native trout," white trout, and black bass—principally the white trout and black bass. The landlocked salmon still exists, but in very diminished numbers. The "native trout" is very scarce in the lake. The white trout and black bass are fairly common, but do not seem to attain as large a size as in former years. Of the salmon family, then, the principal fishing is for chinook salmon and white trout.

The white trout began to decrease in numbers as the landlocked salmon increased. But for some reason the landlocked salmon then began and continued to fall off in numbers, perhaps for reasons suggested in the discussion of that species. The white trout increased gradually in numbers again under improved fish-cultural methods and larger plants. Authentic instances have been cited where chinooks have been found with one or more white trout in their stomachs. An occasional white trout in the salmon's stomach does not prove that it is particularly dangerous to the white trout, but as the chinook is, like the landlocked salmon, notedly pisciverous, it is not unlikely

that the chinook does devour many white trout; especially, as has been pointed out in another place, the disappearance of trout in some waters and the disappearance of the bluebacks from Rangeley Lakes can be laid at the door of the landlocked salmon.

In Sunapee Lake the principal food doubtless is the smelt, which probably even in deep water swims in schools, and on that account is particularly liable to the attacks of chinooks, which, from a foregoing discussion of the chinook's feeding habits in its original waters, subsists mainly upon such fishes as swim in schools. It is not impossible, however, that the white trout may also occur in schools. If so, the trout is surely in danger, and even if the trout are only mingling with and feeding upon smelts they are liable to be snapped up by chinooks also feeding upon smelts. While the unknown factors entering into the calculation are so many as to make the figures of little or no value, the following computation will serve to indicate the tremendous possibilities:

Let each salmon eat one trout each day for 180 days or practically half a year. Then each salmon devours in that length of time 180 trout; 500 salmon would destroy 90,000 trout in that length of time. At this rate it would take only slightly over $2\frac{1}{2}$ years to destroy a number equal to the largest plant of white trout made by the Bureau of Fisheries, less than 6 months to destroy a number equal to the plant of 1911, and only a little less than 23 years to eat up a number equal to all that have been planted by the State and Federal fish commissions in 15 years—something over 2,000,000. (See table.)

The white trout among the Salmonidæ is of unsurpassed beauty, unexcelled delectability for the table, and a most satisfactory game fish, occurring in but a very few known localities in the United States, and diminishing or already extinct in some of them. Here the stock could be maintained, as shown, by the successful fish-cultural operations and a brief respite from salmon. It would be a reproach to exterminate the fish. Will it pay to take the chances and continue to introduce those voracious species, especially the chinook, which is otherwise such an uncertain quantity?

The discussion of the chinook in the foregoing pages relates to conditions up to and including 1911. The large catches of this species in 1912 and 1913 in no way detract from the arguments made in that discussion. The majority of those caught were evidently of comparatively recent plants. In a letter to the present writer, Mr. George H. Graham stated that he had kept a fairly good record of the fish taken in 1912 and considered 1,800 a conservative estimate, and that they ran from $2\frac{1}{2}$ to 6 pounds each. A few of 10 and 11 pounds were also reported. In the same letter Mr. Graham wrote that white trout were caught "about as usual," plenty of them, but not many large ones.

About the middle of May of this year (1913), Mr. W. O. Robinson, of Washington, D. C., who had just returned from Sunapee Lake, informed the writer that many chinooks up to 4 or 5 pounds in weight were being caught this spring, but scarcely any white trout were taken. (For further discussion of 1912 and 1913 see page 91, footnote.)

Observations upon young chinooks.—It seems to be a general impression among those who handle and plant young chinooks at Sunapee Lake that if planted in the brooks they soon go down to the lake, at least after the first heavy rain following the planting. Their presence in the brooks during and subsequent to the runs of smelts gave rise to the idea that they returned to the brooks with the smelts after having been in the lake over winter. Particular attention was given to this point during April of 1910. During this time observations were made several times nearly every day and every night at the mouth of Pike Brook and no young salmon were ever observed entering the brook by themselves or with the smelts, but throughout April some young about 3 to 3½ inches long were present in the brook above the dead water. It is not impossible, however, that they entered the brook from the lake prior to the run of smelts, but, if so, it must have been prior to the breaking up of the ice in the lake.

It was observed that young chinooks planted in the brook at a considerable distance from the lake soon distributed themselves up and down the brook indiscriminately. Some planted not far above the dead water distributed themselves in both directions, but the majority went upstream, those going downstream at first stopping short of the dead water, probably affected by the rise in the temperature of that portion of the brook. An interesting and perhaps significant fact is that the last-mentioned plant was placed in a pool some 3 feet deep which evidently was directly fed by a spring, which reduced the temperature of the water to 50° F., that of the rest of the brook in its neighborhood being about 57° or 58° F. No salmon remained in this pool. Several plants were made here, but the fish invariably left it so quickly that in a few hours none could be found in it. It is also shown that while some of the young salmon made their way up the brook for a considerable distance beyond the place where they were planted, none entered the open water of the meadow, where the temperature rose to 59° F.

At no time during spring and summer were any young chinooks observed entering the lake. In order to ascertain if there were any such movement, a small fyke net set in Pike Brook a short distance above the dead water up to August 16, 1911, contained at any one time only three or four young chinooks and the net almost completely occluded the brook. On the 16th the fyke net was removed to the outlet of the dead water through the beach. About noon of

the 18th there was a heavy downpour of rain. The following morning the net contained 18 young chinooks, which gives some support to the idea that these young fish enter the lake after a heavy rain.

Subsequently larger numbers were found in the net, but the number at any time represented but a small portion of those that had been planted, even in the last deposit.

During the spring and summer the stomachs of young chinooks of the brooks were examined in order to ascertain the character and quantity of food. One taken April 17, 1910, contained caddis larvæ and a lot of smelt eggs. During August, 1911, young taken in the fyke net contained small insects, mostly *Diptera*.

Having examined the shore water of the lake and the water of various parts of the brooks in regard to food supply for young salmon, it was decided that the brooks, especially Pike Brook, were preferable to the lake for the purpose of planting young salmon, not only on account of the greater food supply of the brooks but their comparative freedom from enemies. That there were some enemies, even in the brooks, was evident. At one time two kingfishers were observed industriously catching small fish, presumably young salmon, just above the dead water. On two occasions some trout were opened and found to have been feeding upon recently planted chinooks. One 10-inch trout contained six salmon in various stages of digestion.

Silver Salmon (*Oncorhynchus kisutch*).

The silver salmon, known in Alaska as "coho," has its geographical range from San Francisco probably to the Yukon and on the Asiatic coast south to Japan. It reaches a weight of 15 pounds and averages perhaps 8 or 9 pounds. It is especially abundant in Puget Sound, where it is frequently caught by trolling, and it is stated that these fish take herring bait the year round in Puget Sound and bays of Alaska, and on the offshore banks.

The silver salmon ascends streams, but not so far as some chinooks, and the breeding runs are later in the season. Like the chinook, all die after the breeding function is performed.

The adult fish subsists largely upon other fishes, particularly those that swim in schools, such as the herring, smelts, sand launces, etc. In fresh water the young up to the fingerling stage feed mainly upon insects and the aquatic larvæ of insects, and fingerlings have been found containing small fishes and fish eggs. Yearlings in salt water also subsist largely upon smaller fishes.

It is a good food fish, for packing ranking third of the five species of the genus *Oncorhynchus*. It is also a gamy fighter, but does not excel the eastern landlocked salmon. As it is a voracious fish eater, nothing can be gained by its introduction into Sunapee Lake.

The reports of the Bureau of Fisheries show that in 1909, 15,000 fingerlings (?) were planted in Sunapee Lake. None has as yet been reported, although it is possible that some of the supposed small chinooks may have been silver salmon.

The fish may be readily distinguished from the landlocked salmon, or any other eastern salmonid, by the larger number of anal rays, but this character may not infallibly distinguish it from the chinook. The silver salmon has 13–14, the chinook 15–17 anal rays. Those accustomed to seeing and handling the fish can readily distinguish it by its general appearance and coloration, but this would be rather difficult for one more or less unfamiliar with either the chinook or silver salmon. The color is thus described by Jordan and Evermann in Fishes of North and Middle America:

> Bluish green; sides silvery, with dark punctulations; no spots except a few rather obscure on top of head, back, dorsal fin, adipose fin, and the rudimentary upper rays of the caudal; rest of caudal fin unspotted; pectorals dusky tinged; anal with dusky edging; sides of head without the dark coloration seen in the quinnat [chinook]; males mostly red in fall, and with the usual changes of form.

One who has the patience to count the scales in the longitudinal series immediately above the lateral line will find from 125 to 135 in the silver salmon and from 138 to 155 in the chinook. The most conspicuous internal difference is the number of pyloric cœca, which, in the silver salmon, is from 50 to 80 and in the chinook about 140 to 185.

Landlocked Salmon (*Salmo sebago*).

The attribute "landlocked" is a misnomer, first applied to this fish owing to the early theory that the fish was derived from the anadromous sea salmon having been confined in the lakes by some upheaval shutting off return to the sea. The fact stated briefly seems to be that like many other fishes of the salt and brackish water ascending to fresh water to spawn, some remained in fresh water, thus establishing a fresh-water race or species, if this fish can be considered a distinct species. Without entering into a discussion of this question, it may be said that there seem to be sufficient constant differences to permit of its being so considered. The differences are no more pronounced than they are among other recognized species of salmonids, but they are as recognizable and, so far as has been determined, are real and constant.

Distribution.—The landlocked salmon, for which a better name would be fresh-water salmon, naturally occurred in only a few known localities. The New England fish originally was found in only four river basins, i. e., St. Croix, Union, Penobscot, and Presumpscot. In the St. Croix it occurred in some of the lakes of both branches, but the western branch at Grand Lake is the best-known water for it now. This is the source of the "Schoodic salmon" of fish culture.

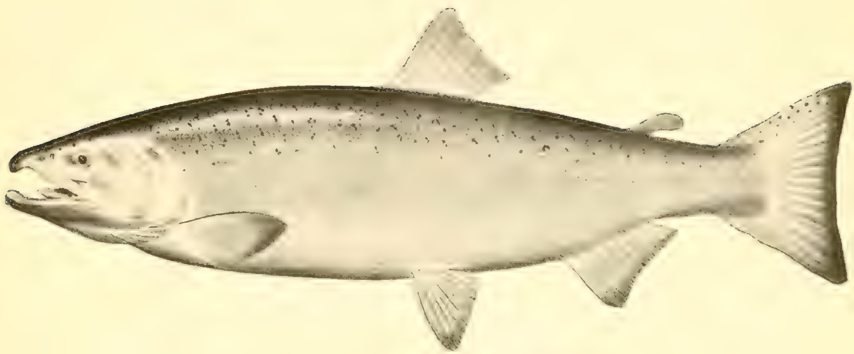

FIG. 1.—SILVER SALMON. BREEDING MALE.

FIG. 2.—LAKE TROUT.

In the Union basin it was found only in Reeds Pond, now known as Green Lake. In the Penobscot, the only water in which it was formerly known is Sebec Lake; and in the Presumpscot, Sebago Lake was the only lake noted for the salmon. From this lake the fish gets its name and there it attains the largest size of any of the waters mentioned.

Culture.—Efforts were made by the New Hampshire Commission to secure eggs of the Sebago and Sebec salmon but without apparent success, so it seems that this fish in Sunapee is the result of plants from "Schoodic" stock. If this is true it shows that the little "Grand Lake salmon" under more favorable conditions attains a much larger size than in Grand Lake.

According to the reports of the State Fish and Game Commission, the first plant of this fish was made in 1867, when 45 or 50 were placed in the lake, and the report for 1877 states that "of the 45 put into Sunapee Lake, 43 are said to have been speared the next autumn on their spawning beds in one of the brooks flowing into the lake." This being so the fish first introduced must have been adults.

The first definite reference to the taking of landlocked salmon in Sunapee Lake is in the report for 1884, where it says: "In the summer of 1883 a large number were caught, weighing 5 to 7½ pounds, in Sunapee Lake." Again, in the report for 1886, it is said:

> In 1884 quite a number were caught from Sunapee Lake; in the fall of 1885 several were caught near the hatching house at New London, from which several thousand eggs were taken, being the first eggs ever taken from waters that have been artificially stocked with this fish in the United States. They have become quite plenty. Large numbers have been taken the present season weighing from 6 to 20 pounds.

The report for 1889 says:

> The work of securing eggs for the hatchery was commenced in September. A fine lot of landlocked salmon was taken the last week of that month. The weight of the spawners was from 4 to 12 pounds. Seventy-five thousand eggs were secured.

And again:

> Sunapee Lake has now become self-sustaining. Seventy-five thousand eggs were taken there last year, which is more than necessary to keep up the fishing to its present high standard, and no benefit has been received from the large plants made during the past three years.

The report of 1890 says:

> The landlocked salmon were found in greater numbers than ever before, and the requisite number for spawners were soon secured. After securing over 110,000 eggs the salmon were allowed to go up the brook and deposit their eggs naturally. This is the largest number of landlocked salmon eggs that has been taken at this station. The spawners were all secured at the mouth of the brook near the hatchway [sic]. The average weight was from 8 to 10 pounds.
>
> The lake is becoming noted far and near as a salmon lake, and the wonderfully rapid growth made by these fish proves conclusively that the water and food supply are well adapted to their wants.
>
> A large number of salmon weighing from 10 to 14¾ pounds have been taken with rod and line the past season.

A correspondent of a sportsman's paper in that year stated that fully 1,000 pounds of landlocked salmon, from 5 to 14¾ pounds, were caught in Sunapee Lake that season. The 14¾-pound fish was the largest then on record.

The report for 1891 states that owing to the unusually low water no salmon could find their way into the brook, and not as many females could be secured as were taken the year previous.

The report for 1892 shows that there was a large increase of salmon over the previous year, and that for 1893 says more of all kinds of parent fish were taken that year than in any previous year, including landlocked salmon. The report of 1894 says:

> What disciple of Izaak Walton while fishing in Sunapee Lake, previous to the organization of the New Hampshire Fish and Game Commission, ever felt the thrill that can only be imparted to the good right arm of the fisherman by striking the royal landlocked salmon, weighing from 10 to 15 pounds? Now that regal fish abounds in those waters to such an extent that hundreds are taken in a single season.

In another place the same report mentions that in 1893, 110,000, and in 1894, 140,000, landlocked salmon eggs were taken, and says:

> Owing to the extreme low water both at Sunapee and Pleasant Pond, our product of landlocked-salmon and brook-trout eggs is not more than one-half what it would have been under favorable conditions.

These are the last references to the abundance of salmon, but for some years longer nearly all of the fish planted were the products of eggs taken at Sunapee Lake, and the number of fish planted will indicate to some extent whether the salmon are holding their own, increasing, or decreasing in numbers.

The report for 1893, however, does not show that any salmon were planted that year. The report for 1894 makes no definite mention of salmon planted in Sunapee Lake, but states that 2,000 were sent to Sutton (probably for Pleasant Pond) and 105,000 to New London (probably for Pike Brook). Unless 5,000 fry allotted to Sutton in 1895 were placed in the headwaters of Pike Brook, no plants were made this year in Sunapee Lake waters. The records begin again in 1896, with 30,000 fry. There seems to have been no plant in 1897, but in 1898 50,000 are recorded for Sunapee Lake. None is mentioned for 1899, although the salmon planted in other lakes may have been from eggs taken at Sunapee. The report for 1900 shows 35,000; those for 1901 to date give no plants for Sunapee Lake, except that 1904 gives 23,000, but it is not certain that these eggs were taken there. All subsequent plants were made by the United States Bureau of Fisheries, perhaps some from eggs taken elsewhere.

In 1904 the Nashua fisheries station party took 36 salmon, 27 of which were males and 9 females, yielding 25,000 eggs; in 1905, 22 salmon were caught, 19 males and 3 females, yielding 1,000 eggs; in 1906, 10 salmon, 8 males and 2 females, yielding 6,000 eggs; in

1907 no salmon were taken; in 1908, 4 salmon were taken, 3 of which were females, but no eggs were obtained; in 1909, 1 female only was caught. An unsuccessful attempt was made to fertilize the eggs with chinook milt.

In 1910 the Nashua fisheries station party began setting gill nets September 15, attempting to get chinooks. Up to October 14, only a few small trout and two landlocked salmon of about 5 or 6 pounds each had been taken.

October 17 three gill nets, each 100 feet long, set in a string offshore in water from 1½ to 4 or 5 feet deep, near the mouth of Pike Brook, just about dusk took two salmon, one a female estimated to weigh 8 pounds, the other a male of about 6 pounds. The male has a strongly hooked lower jaw, and was more slender than the female. The female was plump and pretty, full of roe, but not ripe, although well advanced. The abdomen was plump and hard, contracting about the vent. The male had a short gash in its side which was somewhat fungus-grown.

In 1911, on September 24, Mr. DeRocher caught in a gill net off the "Banks," in about 30 feet of water, a female landlocked salmon; on November 6, in nets off mouth of Pike Brook, one ripe female of strong 5 pounds was taken; and on November 10, at the "Reef," the fisheries party took in a gill net one landlocked salmon 17½ inches long, apparently a male.

The following is a record of the plants of young landlocked salmon in Sunapee Lake, as shown by the New Hampshire and United States Fish Commission reports:

1867	50
1877	700
1878	6,000
1879	10,000
1881	4,000
1882 (by United States)	15,000
1882 (by State ?)	5,000
1884	15,000
1885	10,000
1886	25,000
1887	40,000
1888	45,000
1889	75,000
1890	95,000
1891	65,000
1892	34,000
1894	105,000
1896	30,000
1898	50,000
1900	35,000
1902 (by United States)	59
1903	20,000
1904	3,000
1904 (by United States)	8,250
1905 (by United States)	1,120
1906 (by United States)	13,640
1907	12,000
1907 (by United States)	12,905
1909	4,000
Total	739,724

The catch of "a large number weighing from 5 to 7½ pounds" in 1883 must have been from the plants of the years 1877 to 1882, inclusive, the extreme period of growth to these weights being about five years. In about 12 years from the first plant in the lake Sunapee salmon stock was considered self-sustaining. The fish

planted by the State, presumably from Sunapee salmon eggs, in 1889 was 75,000; in 1890 an increase of 20,000 appears; then a gradual falling off, in 1891 reduced to 65,000; 1900, 35,000; 1902, none at all; but in 1903, 20,000, and in 1904, 3,000, probably from eggs taken elsewhere.

The catches of the United States fisheries station party show a rapid decline in the number of landlocked salmon obtainable in Sunapee Lake for propagation purposes. This is doubtless due to two things: First and directly, to the inability of the fish to find suitable spawning waters. At one time it seems to have been possible for them as well as the trout to enter Pike Brook, but later, owing to low water in the lake and in the brook, too, without doubt, the salmon were unable to enter the brook. The secondary cause, depending upon the first, is the fewer young planted each succeeding year. Yet there are some landlocked salmon in the lake, though they are fast disappearing, as they have no natural breeding grounds and are gradually caught or die naturally.

Habits.—The salmon requires for breeding a gravelly bottom with cool running water, and while it is known sometimes to deposit its spawn along shores of the lake, it is doubtful if more than a few eggs, if any, hatch. The salmon ascends streams to the spawning beds, where it forms its "nest" some time before it is ready to deposit its spawn. In some waters it enters the streams early in September and the State Fish Commission reports indicate that it was found entering the brook or attempting to do so in the latter part of September in Sunapee Lake. The spawning takes place in the latter part of October to some extent, but mainly in November. The eggs hatch in the spring and the young remain in the streams until they attain a length of 4 or 5 and even in a great many instances 8 or 10 inches, thus not subjecting themselves to the dangers that beset very small fish in the lake. If the spawning beds where the fish are hatched are in a large stream, when able to swim the young make their way upstream or into smaller running tributary brooks, if there are any, in this respect just like the species progenitor, the "sea salmon." A few young "landlocks" were observed in 1910 and 1911 in Pike Brook. On April 28, 1910, one fingerling was seen in Pike Brook and on August 12 three about 2 inches long were caught in Blodgett Big Brook. On July 29, 1911, several about 8 inches long were caught by means of hook and line in Pike Brook, and on November 3 one was taken with the outrun of trout from Pike Brook.

The adult salmon is primarily a fish eater, but it also subsists largely upon insects that fall upon the water and aquatic larvæ of insects. In its natural habitat the smelt is its principal food and no landlocked salmon ever occurred naturally where there were no smelts. In fact, the spring runs of the sea salmon seem to be in pursuit of food to some extent at least, and on the Maine coast this is

FIG. 1.—FOURTEEN-POUND LOCK LEVEN TROUT, OR BROWN TROUT.

Identity not certain because of confused records of plants.

FIG. 2.—SIXTEEN-POUND LANDLOCKED SALMON.

largely the smelt, and the smelt may be largely the "obstruction" that landlocked the salmon. In other words, salmon having entered a lake and ascended its inlet or inlets to spawn, as they began to return, finding abundant natural food in the smelt, they were, or some individuals were, content to stay in the lake. Or it may be that the young, lingering as they do in their native streams sometimes for two and three years and there attaining a weight of at least half a pound or more, on entering the lake from the inlet or outlet found congenial surroundings in the way of temperature and food and remained. Whatever the facts of the landlocking process, the one fact remains that it is easy to stock a lake having the requisite conditions with landlocked salmon, thus indicating that but a few, if any, of the salmon attempt to go to sea. The landlocked salmon does, however, in spawning season, descend into outlets, where it breeds. Also salmon have been known to follow a drive of logs, presumably for the sake of grubs and insects dropping from the logs. But young landlocked salmon have never been detected going to sea in the manner of the young of "sea salmon."

The young salmon is largely an insect feeder until it comes in contact with the smelt. It takes whatever insects it finds fallen upon the water and seeks the larval aquatic forms occurring on stones and submerged logs.

Angling.—The usual method of fishing for salmon in the lakes is by trolling with natural or artificial bait, but the fish will take the fly, especially in the early evening, when insects are at the surface of the water. As has been suggested elsewhere, the reason why salmon are not rising to an artificial fly may be because there are no such flies for them to rise to, or there may be no salmon to rise to them, or, it may be added, the fishing may be at an improper season or time of day. In 1890 a prominent summer resident at Sunapee Lake commenting in a sportsman's journal upon the fishing of that season, among other things, said: "Fly fishing for bass never was finer. While casting a small brown hackle the other evening we raised a 10-pound salmon, but he missed the fly." Mr. Ralph Davis states that he formerly caught landlocked salmon on flies at the mouth of Georges Mill Brook. Only one recent definite record of landlocked salmon caught by anglers was available, perhaps, as has been previously suggested, because they were not always distinguished from chinooks. This record referred to a 12-pound fish taken at Split Rock on July 29, 1911.

This fish is unsurpassed as a game fish and is an excellent food fish. Its size and activity make it very attractive to the angler. But the foregoing discussion of its habits indicates that it is an undesirable acquisition where it is desired to maintain the stock of trout. In other places in this paper allusion has been made to the effect of

its introduction into trout waters. The greatest damage has been done in those waters where it was introduced without a preceding or accompanying introduction of smelts. On account of the introduction of smelts, the damage in Sunapee was lessened or shortened. Nevertheless, it appears to have been great, especially so far as the "native trout" was concerned. The writer may be biased, but he deplores the fact that salmon were ever put into Sunapee Lake.

Rainbow Trout (*Salmo irideus*).

The rainbow trout occurs naturally in the streams of the west slope of the Sierra Nevada and the Coast Range Mountains, and is found as far north as southeastern Alaska. There are several local varieties or variations which have been given specific names and which in Jordan and Evermann's "Fishes of North and Middle America" are recognized as subspecies.

The form that has been propagated and distributed by fish culture is the McCloud River (California) rainbow trout, technically known as *Salmo irideus shasta*. Its geographical range is stated by Jordan and Evermann as streams of Sierra Nevada from Mount Shasta southward. It is said to reach a weight of 10 pounds. It subsists largely upon insects, worms, insect-larvæ, and Crustacea, and although it is not naturally a fish eater, when fish are available it does not always disdain them.

In its native waters the rainbow trout spawns during the months of February, March, and April, but it has been found to vary from this in the different places where it has been introduced. At Wytheville hatchery the spawning season extends through November, December, and January, and, to some extent, into February. December and January are the best months. In Colorado the period is from early May until July. It is stated that the maximum number of eggs produced in a single season by a 3-year-old fish weighing ½ to 1½ pounds is from 500 to 800; from one 6 years old, weighing 2 to 4 pounds, it is 2,500 to 3,000.

This fish has been successfully transplanted into streams in the Eastern States where the conditions seem to be favorable. Rainbow trout will live in warmer water than the brook trout. Probably warmer waters are required and the coldness of New England waters may be the cause of the poor results in stocking them with this fish.

Rainbow trout have been planted in Sunapee Lake as such and under the name of "California trout" as follows: 1888, 10,000; 1889, 25,000; 1890, 10,000; 1891, 10,000; 1903, 2,994; total, 57,994.

No one has as yet reported a rainbow trout from Sunapee Lake. However, the comparatively small number planted in the presence of other fish-eating fish may be the reason for the apparent failure to

stock the lake. It is a profusely black-spotted fish, and could be confused with no other salmonoid in the lake, unless possibly the chinook and landlocked salmon. From the former it may be distinguished by the fewer anal rays and from the latter by the finer or larger number of scales in the lateral longitudinal series, the landlocked salmon having not over 120, usually 115, all told, and the rainbow having 145, more or less. It is a delightfully gamy fish as a rule, and readily takes the artificial fly. It usually makes a long hard fight.

Considering the comparative harmlessness of the rainbow trout compared with the chinook and landlocked salmon, it seems a pity that the waters of Sunapee are not more favorable to it and have not received more plants, if it seems necessary to stock it with non-indigenous fishes.

Brown Trout (*Salmo fario*).

The fish better known in this country as brown trout was first introduced under the name of Von Behr trout, after the man through whose instrumentality the eggs were obtained from Germany. It was later called German brown trout and finally just brown trout. In Great Britain it is known as brook trout, burn trout, and brown trout, also having many other names for local variations. In Germany it is the Bach-forelle (brook trout), but it is not exclusively a brook trout any more than the eastern brook trout of the United States (*Salvelinus fontinalis*) is such. It also inhabits lakes, in some of which it reaches a large size, even 50 pounds, if the British *Salmo ferox* is the same species. Day, in his "British and Irish Salmonidæ," 1887, gives the habitat of this trout as the colder and temperate portions of the Northern Hemisphere, descending in Asia as far south as the Hindu Kush, but not normally present in any portion of Hindustan.

It has been introduced into many United States waters, in some of which it has thrived. It is a good game fish, but Henshall says it is not as gamy in this country as the eastern trout (*S. fontinalis*). It will endure warmer water than *S. fontinalis* and may be suited to depleted trout streams which, owing to change of conditions, are unsuited to the brook trout.

Day says:

> The food which trout consume is of various descriptions. One of about 1½ pounds weight, taken in June, 1882, in the Tweed, was found to contain 11 small trout and 1 minnow. They do not object to little fish, as the minnow, loach, sticklebacks, etc, water rats, young birds, frogs, snails, slugs, worms, leeches, maggots, flies, beetles, moths, water spiders, and even a lizard (Field, October, 1885). They will swallow one of their own kind two-thirds as large as themselves. In Mr. Buckland's museum was an example, the stomach of which was distended by 2,470 eggs of apparently the salmon.

Regarding their breeding habits, Day continues:

Trout commence breeding in their second year or prior to their attaining 24 months of age, and often later in the season than their parents. The males are more forward than the females, but at this early period of their lives the probabilities of the ova being healthy and fertile are less than in somewhat older examples. At first the number of males appears to be in excess of the females, but the mortality among them is greater than those of the other sex, until at 3 or 4 years of age the proportion may be expected to be about the same, and subsequently the females predominate. The number of eggs produced by each female trout has been roughly estimated at 800 for every pound's weight of fish, which computation has been observed at the Howietoun breeding ponds to be fairly accurate. * * *

The period at which these fish breed varies in different rivers and districts, extending from October until February, and even, although rarely, to March. * * *

Although trout generally migrate into the smaller contiguous brooks to breed, large ones are more frequently found forming redds in the broader streams than are smaller fish. But it is by no means rare to find large examples having taken possession of pools in burns.

A trout's redd or nest is a mound of gravel which would fill one or even two wheel-barrows, and when by probably causing a shallow may assist in aerating the water. The eggs themselves lie loose among the gravel at from 1 to 2 feet below the surface.

From the foregoing account of the brown trout, it would not seem to be a very desirable acquisition in waters where the indigenous fish fauna is wholly satisfactory.

There seem to be no records of this fish having been introduced as such into Sunapee waters, but as stated in the discussion of the Loch Leven trout it is possible that so-called Loch Levens were brown trout, and Day claimed that the Loch Leven is only a local variation of the brown trout. A 14-pound fish which was supposed to be and was recorded as a Loch Leven trout caught in 1910, but which seems to be a brown trout, affords the only possible record of this species from Sunapee Lake. This is referred to under the account of Loch Leven trout in the following pages.

Loch Leven Trout (*Salmo levenensis*).

This trout derives its name from the lake or loch in Scotland known as Loch Leven. It was formerly supposed to be peculiar to the loch, and the fish of the appearance, form, and coloration of the trout described and named *Salmo levenensis* undoubtedly was peculiar to the lake. It is stated, however, that fish reared from Loch Leven trout eggs in some waters can not be distinguished from the brown trout (*Salmo fario*).

Dr. Quackenbos states that he has fished in Loch Leven and that both kinds of trout were caught there and they are of widely different appearances.

Fish have been reared from eggs supposed to be those of Loch Leven trout sent from England to this country, but they could not

be told from brown trout, which they probably were. Yet there have been some undoubted Loch Leven trout raised and distributed in this country. The two fish as they appear are as different in shape and color as the common eastern brook trout and the landlocked salmon. In fact the Loch Leven up to 2 or 3 pounds strikingly resembles the landlocked salmon in general appearance. It is more slender and silvery than the brown trout, having usually only black X-shaped spots but sometimes round brown spots, and the tail is more forked or emarginate than the brown trout.

The records given in The Fishing Gazette (London) of May 4, 1912, indicate the sizes of this trout as caught in Loch Leven to-day. From these records it was found that 329 trout in the aggregate weighed 240¾ pounds, which gives an average of about 11½ ounces. The largest mentioned was one of 1 pound 14½ ounces.

The Loch Leven trout is also more gamy than the brown trout. Day states that it will eat anything from bread to cockroaches. It is traditional that until in comparatively recent years the Loch Leven trout would not take a fly. Day ascribes this to the disappearance of its former food so that it resorted to insects.

Four plants of what were supposed to be Loch Leven trout have been made in Sunapee Lake. The first is referred to in the New Hampshire Fish Commission report for 1887 as follows:

> Through the kindness of Prof. J. D. Quackenbos, of Columbia College, New York, we have received a present of 30,000 trout eggs from Loch Leven, Sterling, Scotland. These eggs were purchased by Prof. Quackenbos, at an expense of about $5 per thousand, from the Howietoun fishery.

Again in the report for 1888 and 1889 it is stated that 30,000 young were planted in Sunapee Lake, presumably in 1888. The plants were as follows: 1888–89, 30,000; 1890, 10,000; 1891, 10,000; 1892, 25,000; total, 75,000.

Two or more fish have been caught by anglers and pronounced Loch Leven trout. The photograph of one of these, a 14-pound fish, seen by the writer, is believed by him to be of the brown trout, *S. fario*, which, if true, indicates that Day's contention that the Loch Leven trout is but a local variation of the brown trout (*S. fario*) is true, or that some of the supposed Loch Leven trout planted were brown trout, as no brown trout plants have been recorded for Sunapee Lake.

Lake Trout (*Cristivomer namaycush*).

This fish is the lunge or longe of northern New Hampshire and Vermont, the laker of Maine and New Hampshire, the togue of Maine, the Mackinaw trout of Michigan, and the masamacush or namaycush of eastern Canada and Labrador. The Indians of the

interior of Labrador call it namaycush with the accent on the second syllable, according to Donald B. McMillan.

Its recorded geographical distribution is in deep lakes throughout the eastern Canadian Provinces, northern New England States, New York, Great Lakes, headwaters of the Columbia and Frazer Rivers, streams of Vancouver Island, northward into Alaska, Labrador, and the Arctic Circle. In some waters it reaches a weight of at least 100 pounds and varies much in size and color in different waters. It is a voracious fish, subsisting mainly upon other fishes, and is better entitled to the cognomen of "freshwater shark" than the pickerel or pike.

It spawns in the fall like other New England Salmonidæ, and usually upon shoals in the lakes.

In some sections it is highly esteemed as a food fish; in others it is regarded as inferior. As a game fish it is also variously regarded. It is usually caught by trolling or still-fishing, but has been taken on artificial flies. It often puts up a strong fight by powerful, short runs, dragging down, and sulking. It never leaps from the water, and its principal virtue as a game fish consists of its power and the size attained.

As previously stated, it is indigenous to New England waters, but it has also been introduced from the Great Lakes under the name Mackinaw trout. There are no records of its ever having been planted in Sunapee Lake. It occurs there, in limited numbers fortunately, probably gaining access by accidentally getting mixed with other salmonids from some station furnishing the young fish to be planted there.

The following are all of the known records of lake trout taken in Sunapee Lake.

1909.—Two, both males.

1910.—October 18, in nets in front of fishery cottage, Mr. De Rocher got a female 26 inches long. Eggs ran freely, yet judged not fully ripe. It is probable that lake trout do not deposit eggs all at once.

A young man from Sunapee Harbor said that two or three "lakers" had been caught with hook and line this season.

October 20, in the afternoon, near mouth of Blodgetts Brook, a fish with large head and emaciated body, about 16 or 18 inches long, was seen, which from the color of the sides and general appearance was thought to be a lake trout (male). It would not allow a close approach.

Common Trout (*Salvelinus fontinalis*).

This fish is the "native trout" of Sunapee Lake, the name probably of comparatively recent adoption to distinguish it from introduced

forms. It belongs to that group of boreal salmonids properly designated as charrs, is one of the charrs peculiar to North America and has a comparatively restricted range even there. Its stated geographical distribution is from Nova Scotia, New Brunswick, and the New England States to the Saskatchewan and northward to Labrador; also in the Northern States west to northern Minnesota and southward in the Alleghanies to the headwaters of the Savannah, Chattahoochee, Catawba, and French Broad Rivers.

The trout has numerous local names, as squaretail, red spot, brook trout, etc., which like that of Sunapee Lake, serve, locally, at least, to distinguish it from some other forms of Salmonidæ.

The distribution of *S. fontinalis* is governed mainly by the temperature of the water, and in its natural habitat it seems not to endure a temperature of over 60° or 65° F. In many of the long-settled portions of the country where the woods have been cut from the surrounding area and from the banks of the streams, the trout has practically disappeared. In the words of Dr. Henshall, which are a graphic expression of a well-known fact:

> The altered conditions of its aboriginal environment, owing to changes brought about by the progress of civilization, have resulted in its total extinction in some waters and sad diminution in others. In many instances the trout brooks of our childhood will know them no more. The lumberman has gotten in his work; the forests have disappeared, the tiny brooks have vanished. The lower waters still remain but are robbed of their pristine pureness by the contamination due to various manufacturing industries. In such streams the supply of trout is only maintained through efforts of the Federal and State fish commissions. It is hoped by this means the beautiful brook trout, the loveliest and liveliest of fish of all the finny world, may be preserved and spared to us for yet a little while. (James A. Henshall, in "Favorite Fish and Fishing," 1908.)

This article, as indeed most popular trout articles, pertains to the trout as "a brook trout." The trout, while naturally a permanent resident of many brooks and streams, is also a resident of ponds and lakes, in some of which it attains a large size, even more than 10 pounds in weight. The "progress of civilization" has also had its effect on the lacustrine trout. As the fish, whenever possible, ascends streams from ponds and lakes to spawn, the lumbering operations, by destroying the spawning places, have been fully as effective in the diminution of lake and pond trout as of the brook trout, especially in such ponds or lakes as have no suitable spawning grounds in them.

But lumbering operations are not alone to blame for the disappearance of trout or their decrease in numbers. As has been pointed out in another place in this paper, excessive and untimely fishing are most destructive, particularly the catching of fish on their spawning beds and through the ice in the winter. Dr. Henshall, in

the foregoing passage, expressed the hope that through fish culture this fish might be spared "for yet a little while." It doubtless has in many streams and lakes, but fish culture is also responsible for its diminution in numbers, if not complete extinction, in some waters. This, too, has been referred to in another place, but it will bear repetition. The introduction of more powerful and more voracious fishes has resulted in the great diminution of the native trout and, together with or added to the ill effects of excessive and untimely fishing, has in some instances, at least, notwithstanding the efforts to maintain the stock by artificial propagation, almost completely exterminated the trout.

Sunapee Lake itself appears to be a specific illustration of the effects of this combination of causes. This lake, according to tradition, at one time abounded in trout, which was the only known or recognized salmonid of those waters. Trout were killed on their spawning beds, caught through the ice, and netted in the lake from time immemorial, and, as has already been shown, the decrease in numbers of the trout by these means was hastened by the "successful" stocking of the lake with nonindigenous piscivorous fishes, especially the landlocked salmon. To one who will investigate matters it will become evident that where this salmon is introduced and thrives, for some reason or another, the trout diminishes in numbers and in some instances completely disappears. It matters not whether it is because the salmon devour the trout or for some other reason, the fact remains that the two species do not thrive together. It is true that in some waters where salmon exist a good many trout are still caught, but this is due to vigorous stocking of the waters with trout. Unless there is an adequate annual plant, as before stated, the trout gradually "go to the wall."

From 1877 to 1909, inclusive, over 700,000 landlocked salmon, yearlings and fingerlings, were planted in Sunapee Lake waters, and the reports show that from 1880 to 1910 a million young trout were placed in the same waters, or, to be exact, 273,741 more trout than salmon in 30 years of trout plants against 32 years of salmon plants.

In the reports of the New Hampshire Fish Commissioners no reference is made to the propagation of the trout until the report of 1876, where it is recommended that efforts be made to restock depleted streams. In the report for 1880 it is stated that there were in the hatching house 150,000 brook trout eggs, 75,000 of which were sent to Massachusetts and the rest to different parts of the State to replenish exhausted brooks, and in the same report is mentioned the first plant in Sunapee Lake from eggs of the "Rangeley trout." While the commission continued to hatch and distribute trout each succeeding year, no mention is made of any more being planted in

Sunapee until 1882, when a small lot was placed in the brook or lake at Newbury. The next report is that covering 1883 and 1884, in which the first mention of the trout of Sunapee Lake is made as follows:

The drought for the past two years has been very severe for the many trout streams of the State. Some of them have been nearly dry. * * *

Upon examination of the waters of Sunapee Lake, it was thought that a large number of brook trout spawn could be taken from the brook which enters the lake at Cass Landing in New London, where for many years they have ascended in large numbers during the spawning season. Hundreds have been taken with nets and clubs. So many had been destroyed that the commission was requested by citizens residing near the lake to protect it in order to increase trout fishing in those waters.

Dr. J. D. Quackenbush [sic], the owner of the land through which this brook runs, desiring its protection, has leased the brook and adjoining land to the State for a term of years at the nominal rent of $1 a year. By permission of the governor and council, a small hatching house has been erected on this brook but a short distance from the lake of sufficient capacity to hatch half a million of spawn annually. The cost of the house is about $270.

On account of the extremely low water caused by the large amount of water taken through Sugar River the past summer and fall for manufacturing purposes, drawing the water several feet below the usual low-water mark (in September it was lower than ever known before), the trout could not get into the brook, much to the disappointment of the commission, who had made arrangements to take a large number of spawn. Several large trout were taken in the lake near the inlet in shoal water. They yielded 15,000 eggs, which were successfully hatched and placed in the lake. * * *

Again, in the report for 1885 the following appears:

In the house at Sunapee Lake are 65,000 brook-trout eggs. Many more would have been obtained there had it not been for the loss of many fish killed by thieves and poachers. Fortunately three of them were caught one night in the very act, and were fined $100 and costs each. It seems almost incredible that intelligent men, knowing the object of the work that was being done, would have placed themselves in so humiliating a position merely for the sake of a few pounds of fish unfit for food at that season. For years it has been the practice of these men, and their fathers before them, not only to kill every trout that came into the brooks in the fall, but to line the shores of the lake with gill nets, thereby destroying large numbers of trout as they came into the shoal water for the purpose of spawning; and they wonder why the fish have decreased. I only wonder that there is a trout left in the lake.

This body of water, with proper care, can be made one of the finest trout lakes in New England. The trout are very large, 5 or 6 pound fish not being rare, and some have been taken weighing 9 pounds, and the large ones all get away, at least so say the fishermen, and while it is an easy matter to add to our food fishes by the introduction of new varieties and increase our native fish by artificial propagation, when we come to our wild game it is another question.

In the report for 1886 it is stated that at Sunapee Lake the commission succeeded in securing enough adult trout to yield 100,000 eggs, the trout being returned to the lake after the spawning season.

Again in the report for 1887 reference is made to the former poaching and the difficulty encountered with poachers in the operation of the hatchery, which was finished late in the fall of 1884. The fol-

lowing extract regarding the trout is of interest in this connection, indicating that but a few trout were supposed to be left in the lake:

In 1884 many complaints were made to your commissioners regarding the illegal destruction of the trout in this lake during the breeding season.

During the months of October and November it was said that the trout came into the brooks in large numbers, where they were killed with nets, spears, guns, and clubs. An investigation was made, and the commissioners were convinced that the complaints were well founded. It was proved beyond a doubt that it had been the custom to kill every trout that could be found either upon the spawning beds or attempting to reach them. It was evident that something must be done in order to save the few brook trout remaining in the lake. * * *

Three of these poachers were caught in the act. * * * Since that time no attempt has been made to interfere with the work being done, and so marked has been the increase that one night last season 40 trout were taken weighing from 1 to 6 pounds each, and eggs enough to fill the house to its utmost capacity were easily obtained, and the number taken might have been doubled had there been room for them.

Twenty thousand landlocked salmon eggs were taken and more could have been secured if there had been room for them in the house.

The report for 1888 states that the water was unusually high and most of the trout were taken in pound nets set at the mouths of the brooks. It is stated that eggs were taken from trout of from 1 to 7 pounds.

The report for 1891 says the number of brook trout taken was much larger than the previous year.

The following is quoted from the report for 1892:

The first brook trout [at Sunapee] were taken September 13. The large increase in the number of these trout taken this year shows the effect of the heavy plants made the last four years, the number being double that taken last year.

The report of the Sunapee Station for 1892 says that the first trout were taken September 14 and that there was a large increase of salmon, but that, owing to stormy weather, not as many brook trout were secured as last year.

The biennial report for 1893 and 1894 indicates that 250,000 "brook trout" eggs were taken at Sunapee Lake in 1893 and 45,000 in 1894. Regarding the conditions in 1894 the report says:

Owing to the extreme low water, both at Sunapee Lake and Pleasant Pond, our product of landlocked salmon and brook trout eggs is not more than half what it would have been under favorable conditions.

And in another place:

Previous to the existence of the commission there were almost no fish, of the better varieties, in that beautiful lake [Sunapee]. To-day as a direct result of the labors of the commission, it abounds in beautiful brook trout, many specimens of which are taken each season, weighing from 3 to 6 pounds each, and this magnificent fish abounds in those waters to such an extent that no sportsman possessing a fair degree of skill and a reasonable amount of patience, can cast his line therein without a reasonable reward for his labors.

The following is a chronological list of the records of plants of the common trout in Sunapee Lake and tributaries as shown by the State and United States Fish Commission reports:

PLANTS OF COMMON TROUT IN SUNAPEE LAKE.

Date.	Number.	Where planted.	Date.	Number.	Where planted.
1880	[a] 2,500		1899	40,000	Tributaries of Sunapee Lake.
1882	5,000	Newbury.	1900	35,000	Sunapee Lake.
1886	55,000	Sunapee Lake.	1901	4,665	Do.
1887	100,000	Do.	1902	3,000	Do.
1888	[b] 150,000	Do.	1905	2,000	Do.
1889	80,000	Do.	1906	1,500	Do.
1890	50,000	Do.	1907	11,000	Do.
1891	68,000	Do.	1909	5,000	Do.
1892	125,000	Do.	1910	6,000	Do.
1894	[c] 165,000	Tributaries of Sunapee Lake.			
1896	50,000	Sunapee Lake.	Total	1,008,665	
1898	50,000	Do.			

[a] "Rangeley trout."
[b] Eggs taken at Sunapee Lake.
[c] 5,000 are stated to have been delivered at Newbury. It is uncertain where they were planted.

NUMBER OF COMMON TROUT, PROPORTION OF MALES TO FEMALES, AND NUMBER OF EGGS TAKEN BY THE UNITED STATES BUREAU OF FISHERIES IN SUNAPEE LAKE FROM 1904 TO 1911, INCLUSIVE.

Year.	Trout.	Males.	Females.	Eggs.
1904	82	41	41	99,000
1905	69	47	22	64,020
1906	181	82	99	253,344
1907	46	20	26	71,462
1908	47	31	16	22,940
1909	8	5	3	5,600
1910	.....	.....	.....	.....
1911	.....	.....	.....	.....

The records of the number of eggs taken each year are not consecutive. From 1893 to 1903, inclusive, there are 11 years of which no records seem to be available. The number taken in 1892 was, as previously stated, 125,000. In 1904 there were only 99,000 secured, but in 1906 the unprecedented number of 253,344 were secured. The average number of eggs to each fish indicates that the fish averaged a fairly large size. That year (1906) 181 trout, as previously stated, were caught; in 1907 the take dropped to 46, in 1908 to 47, and in 1909 to 8, and in 1910 and 1911 the catch amounted to practically nothing so far as the eggs obtained were concerned.

While there are no conveniently available records of trout taken by anglers in the past few years, the general impression is that they are now too scarce to gratify the angler more than very seldom, and it is plainly evident that not enough can be secured there at present to restock the lake. And this is in spite of the fact that the brooks still contribute to the lake a good many small trout.

Habits.—The trout is almost omnivorous, as fully, if not more so, than the pickerel. In lakes where smelt or other available fish abound it subsists largely upon those fishes. An $11\frac{3}{4}$-inch trout caught in August at The Hedgehog in 90 feet of water was gorged with larval smelts. In brooks the trout subsists largely upon insects but eats any other fish and even its own kind at times. A 5-inch male trout

taken in Pike Brook in April had been eating smelt eggs and larval insects, and two other larger ones were found to contain partly digested adult smelts, the remains of which, in each instance, measured 4 inches.

On April 24, in a pool in Pike Brook, a trout 8 inches long, with protruding, apparently blind eyes, was found near the hatchery. It was probably a fish that had been hooked a few days previously and one eye injured by the hook, the injury or inflammation extending to the other eye. The trout when first hooked was a beautiful, bright colored, plump fish. At this time it was somewhat emaciated and very dark colored, probably due to blindness, and thus indicating that change of color in a fish may depend, to some extent at least, upon sight. It was interesting to note that its stomach contained a partly digested smelt, the undigested portion about 4 inches long, which must have been recently ingested.

Small trout from 3 to 10 inches long were observed in Pike and Blodgetts Brooks throughout the season, and whenever there was water in King Hill Brook some trout were observed there. It was stated by persons familiar with the brooks and their condition that all the trout left the brooks and went into the lake after the first heavy rains in November.

On August 18, in the pool near the hatchery in Pike Brook, a school of at least 60 or more trout from 2 to 9 or 10 inches long was observed and they were still there about November 1. On October 30 and 31 many trout were seen in the brook as far up as Alaria Springs, but on November 2 only a few trout, perhaps 6 or 7 inches long, seemed to be left in the pool and but few observed elsewhere. On November 3, a very rainy day, about 3 p. m., three trout 5 to 10½ inches long were found in an overflow pool in the beach formed by a rise in the brook that day. The brook was pretty high and running swiftly through the beach. In the evening a great many trout were seen running down and 30 or 40 were caught. A small percentage of them would range from 5 to 10 inches in length (but the majority were smaller), many of them spent fish. A 10½-inch trout was a spent female. The biggest run was early in the evening. The fish were descending head first. None was seen headed up brook except when startled, when they would sometimes run upstream. These trout evidently had not tried to get out of the shallow overflow, as there were two quick-flowing outlets.

On November 4 a few trout 5 or 6 inches long were seen in Big Brook and many in Little Brook at Blodgetts Landing, and on November 5 a few, perhaps 3¼ to 6 inches long, were observed in Pike Brook below the hatchery, but none above as far as Alaria Springs.

No direct observations were made upon the spawning habits of trout in Sunapee Lake. From the foregoing quotations and notes it is seen that formerly the trout ascended the brooks to spawn. The principal brooks frequented were Pike and Blodgetts Brooks, especially the former. In the fish cultural operations of recent years the trout were taken along the shores, principally near the mouths of brooks and very seldom on the "Reefs." It is probable that even now the few trout that breed in the lake attempt to enter the brooks and failing that they deposit their eggs in shallow water along the shore. In evidence of this it may be stated that on October 19 a pair, a male of perhaps $2\frac{1}{2}$ or 3 pounds and a female estimated at 2 pounds, was discovered in a slip in the boathouse at Blodgetts Landing, which is not far distant from the brook. The female, constantly attended by the male, swam slowly about. The position of the male in relation to the female was always above her so that he could swim over, barely touching or just free from her. He was never below or alongside. This relative position was maintained during the several observations made upon them during that day. On the 20th the fish had gone, probably having been disturbed by the frequent outgoing and incoming of a motor boat.

Size.—The trout varies in size according to the conditions of environment, in some waters attaining maturity when small and remaining small. In other places it grows rapidly, attaining a considerable size before maturity and reaching a weight of 10 pounds or more.

There seems to be very little that can be learned regarding the size obtained by trout in Sunapee Lake prior to the beginning of fish culture. In Forest and Stream of September 2, 1886, Dr. Quackenbos gives the following records of "largest trout" caught in Sunapee Lake, but no definite dates appear: George Farmer, of Newbury, one of 12 pounds, 30 years ago; J. C. Stickney, North Point, one of 10 pounds; Frank Jewett, Pike Shore, one of 9 pounds; Alvin Haskins, one of 7 pounds 14 ounces, in Pike Brook. Dr. Quackenbos states that the largest "couplet" that he had on record was 13 pounds, and the best sweep by the seine fishermen was in 1837, at Newbury, when 40 brook trout from 1 to 5 pounds each were taken in 15 minutes.

Previous quotations from the New Hampshire Fish Commission reports show that in 1883 trout were taken weighing from 1 to 6 pounds, and again in 1888 that the fish taken ranged from 1 to 7 pounds.

If the native trout in those early days attained a large size, there must have been abundant food, especially in the form of young and small fishes. Trout do not reach a large size on an exclusively insect diet, probably because such food is seldom sufficiently abundant to supply the required nourishment to a large number of fish. Where the chub and redfin occur, unless under unfavorable conditions, they

are usually abundant, and it may be inferred that those species were once more plentiful in the lake and perhaps contributed to the size of the trout. Elsewhere in this paper it has been suggested that the white trout was once small, as was formerly the case with the blueback of Rangeley Lakes. If this hypothesis is true and the Sunapee "native trout" reached a large size prior to the advent of smelts, the small white trout might have formed its principal food, as the small blueback is said to have done to the Rangeley trout and to which fact was ascribed the noted large size of the Rangeley trout of years ago. However, after the introduction of smelts the records show that the trout grew to a large size and were numerous in the lake, but decreased in size and numbers, at first gradually, later rapidly, because of the poacher and introduced carnivorous fishes. The introduction of smelts then probably protracted the existence of the trout to some extent, as it furnished abundant, easily obtainable food, which on its part did little or no damage to other fishes. Whatever the cause, it is evident that the trout is now comparatively rare and does not attain the large size that it formerly did, because it does not have time before it is caught.

The smallest trout that the writer observed in the lake, or taken from it, was one of 9¼ inches in length, which was caught April 23, 1910, on live smelt bait, set over night at Curtis's Pier. Its stomach was empty. On August 16, 1911, one about 10 inches long that must have come up from the lake was seen in the mouth of Pike Brook in the beach below a fyke net that completely occluded the brook.

Stocking of the lake.—The habit of trout spawning in brooks whenever possible and that of the young remaining in them for some time indicates that the brooks afford the most natural conditions in which to plant young trout.

The fact that large numbers of trout descend to the lake late in the fall during or after heavy rains offers no unfavorable argument toward planting them in the brooks. Although small, the majority of the trout thus migrating seem to be adult fish. It is at the time of the year when the shore waters are cool and the fish are not, on account of temperature, obliged to seek the deep water with its attendant dangers. Trout fry undoubtedly remain in the brooks over winter and food for such small fish is far more plentiful in the brook than in the lake at that season. While fish, young or adult, require less food and feed less in the winter than at other seasons the fact that hatchery-bred fish are liberally fed up to the time they are planted would seem to indicate that they should be planted where they can obtain the most natural food in order that they may not suffer from the sudden cessation of food supply. It has been suggested that salmon fry planted in the brooks in the spring would produce more successful results than even larger fish planted in the lake

in the fall. The reasons are the foregoing. To plant them in the lake in the spring would only subject them to further disadvantages in the way of hungry and voracious fishes. While food is plentiful enough in the lake during the summer the shallow water that the young salmonid would naturally seek is not only too warm but infested with enemies, as is also deep water to which they would be compelled to resort for sufficiently cool temperature. Disregarding the lack of food, the late fall is undoubtedly the best time for planting them in the lake, as then the shore waters are cool and comparatively free from enemies.

Blueback Trout (*Salvelinus oquassa*).

This species of trout was originally discovered in the upper lakes of the Rangeley chain and was described by Girard in 1854. It has always been considered as peculiar to the Rangeley Lakes, where it

Fig. 2.—Blueback trout.

abounded in the early years, ascending a few streams in countless multitudes in October to spawn, and where it was caught in dip nets by the barrel and even by the cartload by the inhabitants, and cured for winter use. In the course of time the fish became so diminished in numbers that the commissioners brought about the enactment of a protective law for this fish which hitherto had never been protected, but it continued to decrease until the present time, when it is nearly, if not absolutely, extinct in those waters. The alleged cause of the decrease was the excessive and unseasonable fishing by the inhabitants of the shores of the lakes. But these people had fished in the same way and to the same extent for more than 50 and perhaps 100 years with no perceptible diminution in the number of trout.

One of the first acts of the State fish commission after its establishment was to introduce landlocked salmon in the Rangeley Lakes. The diminution in numbers of bluebacks was in direct ratio to the increase in numbers of salmon. The salmon now abound in those lakes. The bluebacks are no more, and not only that, but trout have decreased in numbers notwithstanding the bounteous annual plants of young.

A curious phenomenon was connected with the disappearing bluebacks. The original blueback never attained a size over 9 or 10 inches in length, or much over one-fourth of a pound in weight. In 1895 the smelt was first introduced, and it increased in numbers rapidly, so that in 10 years these little fish fairly swarmed in the lake and in the spring breeding season they were washed up in windrows on the shore, much to the annoyance of those living near the shore, owing to the stench of rotting fish. After the introduction and increase in number of the smelts, occasionally a large blueback was caught on a hook, that is, a fish that would weigh a pound or more, and in the fall seasons of 1901 to 1904 in Rangeley Stream the few bluebacks that were found there by the State fish hatchery operations were all large ones, weighing from 1 to 2 pounds or more. Since then no bluebacks, to the writer's knowledge, have been taken in Rangeley waters, and he has endeavored to keep in touch with the matter. The increase in size of the few remaining bluebacks is ascribed to the smelts upon which they probably subsisted.

The reports of the State fish commissioners of New Hampshire indicate that on April 26, 1878, 3,000 and again on June 3, 1879, 4,000 young bluebacks were planted in Sunapee Lake.

They have never given evidence of their presence in the lake, unless the white trout of that lake are the results of those plants, which was at one time contended by some. This will be discussed in connection with the latter.

White Trout (*Salvelinus aureolus*).

Description.—The "white trout" of Sunapee Lake is one of that group of salmonid fishes properly known as charrs, of which, in this country, the common trout (*Salvelinus fontinalis*) is the best-known member. It is closely related to, if not specifically identical with, the European charr otherwise known in this country by the German name "saibling" (*Salvelinus alpinus*), and very close to the only charr occurring on the Pacific coast of the United States, *Salvelinus bairdii* (*S. malma* Jordan and Evermann in "Fishes of North and Middle America").

The Alpine charr occurs throughout central and northern Europe, to some extent in the British Isles, as nominal species, varieties or forms of *Salvelinus alpinus*, and in closely related or identical forms in Spitzbergen, Iceland, Greenland, Arctic North America, and Siberia. Many forms of the saibling have been described as distinct species, but the supposed distinctive characters, upon study of an increased amount of material, have been found to be only individual variations. On the other hand, some forms have been found to possess differences that are group variations more or less local in character which may be of specific value.

WHITE TROUT. BREEDING MALE.

The difficulty with which such value is determined among these fishes, however, is well illustrated in the case of the white trout of Sunapee Lake, which was at first and at the same time pronounced by two eminent ichthyologists to be the common trout. Later by one it was said to be the European saibling, and by the other the blueback trout of Rangeley Lake, some of which had been planted in the lake. The latter at that time considered the "blueback" identical with the saibling forms occurring from New England through Quebec, Labrador, and Greenland, but possibly not indigenous to Sunapee Lake. The other stoutly maintained that "the affinities of this form are closer to the saibling by the way of an Atlantic steamer than by way of Greenland and Iceland." The same form, however, was known in Floods Pond, Me., long before the saibling eggs from Europe were received in this country. Again, the second-mentioned authority later pronounced the Sunapee white trout a species new to science and described it under the name of *Salvelinus aureolus*, and the first authority described two smaller forms as *Salmo* (*Salvelinus*) *agassizii* and *Salvelinus marstoni*, respectively. On top of all this one of the most distinguished ichthyologists in this country, and one with whom the describer agreed, decided that *S. agassizii* was only a local variety of the common trout (*S. fontinalis*), notwithstanding not only its difference in shape and color, but the fact that it was said to possess teeth on the "hyoid bone," or "root of the tongue," a difference that was supposed to distinguish the saibling forms from the common charr (*S. fontinalis*).

Notwithstanding the absence of prominent structural differences, there is a question whether it is not well to recognize slight differences of that kind in connection with those of size, color, and habits, at least locally constant and fixed. It has been said that species are not entities and that the term is only an expression of our ignorance. So it might be said of many other things and terms. The writer can not subscribe to this view, but regards the use of specific as well as other terms used in classification as expressive of what is known.

Classification is not wholly theoretical and of use to the taxonomist alone. It is of practical use to the fish culturist. It is of value to him to know that one form attains only a small size and ascends streams to spawn, and that another form reaches a weight of 6 to 8 pounds and spawns on shoals in the lake, and to have names by which to distinguish them. From the fish-cultural standpoint, based upon what is known of the fish, these two forms are or should be regarded as distinct species in order that the fish-cultural distribution may be rational. But if the transfer of the one form from its habitat to the habitat of the other results in the change of the structure, color, and size of the fish to that of the occupant of the water to which

it is transferred, the distinctive names are no longer of any use. A knowledge of the conditions of the respective habitats alone becomes essential to the successful results in the fish-cultural distribution of the fish.

It is therefore very desirable for fish culturists to know whether the comparatively insignificant little bluebacks of Rangeley Lakes transplanted into Sunapee Lake became the large, important food and game fish of the latter lake. The protracted and animated discussions of this question in various sportsman's journals and other publications never settled the question, nor can it ever be positively determined. All that can be done now is to deduce approximate probabilities from the known facts bearing on the matter.

Occurrence in Sunapee Lake.—The reports of the New Hampshire Fish and Game Commissioners indicate that on April 26, 1878, and again on June 13, 1879, 3,000 and 4,000 young bluebacks were, respectively, planted in Sunapee Lake, surely a small number from which to expect immediate extensive results.

According to Dr. John D. Quackenbos,[a] as far as is known the first specimens of this new fish to be distinguished from the well-known forms were taken in Sunapee Lake during the summer of 1881.[b] The fish taken weighed from 2 to 3 pounds each. Dr.

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[a] The Sunapee Saibling: A fourth New England variety of *Salvelinus*. Transactions New York Academy of Science, vol. XII, 1893, p. 140.

[b] In Forest and Stream, Dec. 18, 1890, p. 435, Dr. T. H. Bean adduces evidence that the white trout is indigenous to the lake, from information furnished him by Commissioner Hodge. Commissioner Hodge was an earnest advocate of the idea that it was native and the various disputants discredited this evidence. While it has not been admitted in the discussion of the trout in this paper as positively authentic, it is in line with what has been stated regarding what usually occurs when a strange fish is discovered (p. 124). Dr. Bean writes:

"During a visit to New Hampshire, in October of this year, the writer first met his friend and correspondent, Col. Elliott B. Hodge, a gentleman whose name is throughly identified with fish culture and protection in the State which he loyally serves as fish and game commissioner. We were at Plymouth and Sunapee Lake together, and discussed many objects of mutual interest, among them the golden trout, which Col. Hodge first brought to the notice of ichthyologists and which was introduced to the general public through the columns of Forest and Stream. From him I learned many interesting things relative to the history and habits of the new trout, and, as they have an important bearing upon the inquiry now being made into the relationship of the golden trout to the introduced saibling, I think this an opportune time for making the information public.

"Mr. Pike, who was born and brought up at Sunapee Lake, says that about 25 years ago he and his father saw a great school of trout in the lake. They caught a good many of them, but never looked for them again, because they supposed it to be a mere chance occurrence.

"Mr. Nat. Lear, of Newbury, N. H., told Col. Hodge that when they were building the Concord & Claremont Railroad, in 1872, shortly after the introduction of smelt, he and some others were catching smelt at the mouth of Beech Brook one night (this brook is a tributary of Sunapee Lake), when they saw what they supposed to be a large sucker and dipped it up. It proved to be a white trout of 4 pounds, and looked to him, as he remembers it, just like the *aureolus*, which he has seen since. It was very white and silvery.

"Mr. Moses Gould, of Bradford, N. H., who was one of the earliest trout fishermen on the lake, and fished from boyhood, claims that in 1873 he caught two large trout of this kind in Sunapee and showed them to a number of persons as a very peculiar trout.

"About 1873 or 1874 Thomas Roach caught two trout through the ice in Sunapee, one of which weighed more than 7 pounds. Up to 1871 Sunapee Lake was practically unknown as a fishing lake for trout, and there were scarcely any boats on the lake. The little fishing that was done was chiefly for pickerel. No one fished in deep water for trout until their accidental discovery in great depths about 1881 or 1882. The *aureolus*, being a very late spawner, came onto the shoals at a time when there was little or no travel across the lake.

"A Mr. Peabody stated that in 1881 or 1882 he saw a big school of suckers on the shoals south of Loon Island, Sunapee Lake. Of course there is little doubt that these were golden trout."

Quackenbos states (loc. cit.) that in the two following years, 1882 and 1883, a sufficient number were taken to excite comment. In October, 1885, Col. Elliott Hodge, then State fish and game commissioner of New Hampshire, had his attention called to the fish, accidentally discovered in vast numbers on a "mid-lake rocky shoal." He wrote to Dr. Quackenbos: "I can show you an acre of these trout, hundreds of which will weigh from 3 to 8 pounds each. I could never have believed such a sight possible in New Hampshire."

Thus it appears that three years after the first lot of bluebacks were planted specimens were taken weighing 2 and 3 pounds and still more and larger ones in the next few years. In five or six years at most they occurred in prodigious numbers, "hundreds of which would weigh from 3 to 6 pounds each."

Taking into consideration the probable abundance of food in the form of smelts, it would not be surprising that in 6 years the fish might attain 6 pounds or more in weight, allowing an average increase of 1 pound to the year, which is a stated estimate for the common trout under favorable conditions. But when the abundance of predaceous fishes like the common trout, landlocked salmon, perch, and others, are taken into consideration, it might be doubted that in that length of time such a multiplication of the species would result from such a small plant as 7,000, even under the most favorable of other conditions, especially when the extinction of the blueback in the Rangeley Lakes, as has been pointed out, is doubtless due to landlocked salmon.

The Rangeley blueback has been planted in various other lakes of Maine and New Hampshire where the conditions were apparently fully as favorable for it as Sunapee Lake, and none has since been reported. This, however, does not prove that Sunapee is not an exception, but is collateral evidence. Furthermore, the same white trout has been discovered in other New Hampshire, Maine, and Vermont waters where no red, white, or blue trout has ever been planted and where they could not gain access from their native waters save through the instrumentality of man; and it is not impossible that it may yet be found in waters where it is not at present recognized. The later discoveries just referred to do not prove that the Sunapee white trout did not result from the blueback introduction, but are evidence to the contrary, showing that there is no necessity to account for its presence in Sunapee Lake by man's intervention. There is no record of the introduction of any other fish than the blueback which could possibly account for its presence. It has been absolutely proved that none of the products of European saibling eggs ever reached Sunapee Lake. If not a blueback or a saibling, and not indigenous, where did it come from?

The fact that it was "never observed" prior to this time may be a matter of not recognizing it as distinct from the common trout, or as Dr. Quackenbos suggests (loc. cit.), "in the ignorance of the few who in old times may ever have seen it, and who cared for nothing beyond the fact that it was good to eat."

It is quite possible that before the smelts were introduced the Sunapee white trout was small like the blueback of Rangeley Lakes, on that account never taking the hook and never observed, as it did not ascend the brooks to spawn; and that, like that species, it did not attain a large size, until after the introduction of smelts, owing to scarcity of food conducive to such growth. But there is no way to prove this.

That a fish may exist in a body of water for many years without becoming generally known is not so strange as at first thought it seems. Many resident fishermen and even nonresident anglers have caught at times fish that were more or less strange in appearance. In such cases they discuss the identity among themselves and perhaps come to the conclusion that it is a freak form of some other fish, which it to some extent resembles. When not accounted for in that way it is usually ascribed to hybridization, or if a fish with which they are not familiar has been introduced it is likely to be considered that form. But seldom is it suggested that it is a hitherto unrecognized species, and usually instead of sending it to some competent authority for identification it is taken home and eaten or given to the cat or hens. But when some more observing person detects a hitherto unrecognized fish, many others remember that they have caught the same thing at one time or another. Of course there are instances of forgotten or accidental introductions of fish which when discovered can not be definitely accounted for, but in most instances such can be determined. The white trout, for instance, was at first thought by some to be the result of a plant of some fish from the St. Johns River, an account of which is given by Dr. Quackenbos (loc. cit.). But it is well known that no such fish occurs in the St. Johns River, and it was finally decided that the supposed St. Johns River fish were landlocked salmon from Grand Lake stream, Maine.

Habits and food.—The habits of the American saibling are essentially like those of their European congener. They are what may be termed deep-water fishes, at least in the southern part of their geographical range, occurring in shallow water, as a rule, only when the water is cool, principally in the fall breeding time and early spring. Occasionally in summer one may be seen at the surface in early evening or on a cool, cloudy day, but it apparently does not remain there long. Such appearances at the surface seem to be on account of insects upon which the fish occasionally feeds.

Deep water in this section is affected undoubtedly on account of its coolness, as in the far north the fish are found not only in shallow lakes but in streams. The saibling of the far north and as far south as southern Labrador and Newfoundland, and perhaps the north side of the Gulf of St. Lawrence, in common with the "brook trout," has sea-run forms, as have the saiblings (*S. bairdii* and *S. malma*) of the Pacific. In fact, in those regions they are best known as "sea trout."

That the "sea-running" habit is not possessed by the more southern forms is easily accounted for by the remoteness of their habitats from the sea and the obstructions in the waterways.

The food of the different forms varies according to locality and size of the fish. In localities where fish are suited to their maw and taste, such form their principal sustenance. They feed to some extent upon insects, especially the larval or aquatic forms.

An article by S. Garman in a sportsman's journal in 1891 says: "In New England the habits of the saibling would seem to be the same as on the other side of the Atlantic. Of such as were examined the stomachs were filled with small fishes, mainly smelt, and in several cases with spawn."

The larger white trout examined by the writer at Sunapee Lake always contained smelts when there were any stomach contents at all. Several ranging from $5\frac{1}{2}$ to $8\frac{1}{4}$ inches in length caught at The Hedgehog in about 90 feet of water also contained smelts.

The following observations on very young white trout were made in 1910. April 23, along the shore of Soo-nipi Park, principally over coarse gravel and over sand beach near the gravel, several young were seen and four of them caught, each about 1 inch long. When disturbed they would swim and dart about, hesitating to go far into deep water. But if they went toward shore they would not conceal themselves under the gravel, but seemed to depend for protection upon darting and dodging, at which they were quite adept. Apparently becoming tired, however, they swam more slowly and were easily caught. Their stomachs contained larval diptera (*Chironemus*) and some minute crustaceans (*Entomostraca*). April 28, at the head of Pike Brook deadwater, eight specimens 1 to $1\frac{7}{16}$ inches long were caught. Their stomachs also contained principally *Chironemus* larva.

The breeding habits also vary, as they do in the European saibling. Some forms ascend streams in the fall to spawn, others spawn upon shoals in the lakes.

The white trout of Sunapee Lake, during the summer months, resides in depths of from 60 to 90 or 100 feet, where the temperature is in the neighborhood of 50° F. or less. In the spring it occurs in shallow water about the shores and is often caught from the wharves and piers. In the early part or middle of October it appears on a

shoal near the entrance to Sunapee Harbor, to spawn, and the run continues approximately one month. This seems to be the only spawning place in the lake. At least, in the search that has been made for other grounds, none has been found.[a] This is the shoal where the fish was discovered in such numbers by Commissioner Hodge. The shoal consists of coarse gravel and sand thickly interspersed with bowlders of various sizes, and, as has been previously mentioned, is contiguous to deep water. The water on the shoal varies, of course, with the level of the lake, but it averages from a foot to 6 or 8 feet in depth in places. A phenomenon was noticed on the shoal which may account for the peculiar suitability of the place for a spawning ground of the fish; that is, whenever a light breeze is blowing from any quarter, even from the side most protected from the wind, there is always a perceptible current across the reef, and at times quite strong, in the same general direction of the wind. The temperature of the water at the beginning of the breeding season is from 40° to 45° and later about 33°.

In the spawning runs males at first predominate. The action of the fish on the ground has not been fully observed, or, if observed, has not been described. Such observations, however, are difficult, owing to the fact that the runs occur at night.[b]

The following table shows catches by night on "The Reef" during the month of October, 1910, showing the proportion of males to females:

Date.	Total.	Males.	Females.	Date.	Total.	Males.	Females.
Oct. 21	7	6	1	Oct. 29	....	....	....
23	12	11	1	30	46	6	40
24	49	37	12	31, Nov. 1	30	2	28
26	40	30	10				
27, 28	96	51	45				

Up to the 29th females were in the minority and during the latter part of the month greatly predominated. This may be due to the fact that the males running first were nearly all caught.

[a] In the American Angler of Feb. 19, 1887, Dr. Quackenbos stated that in the previous fall the "oquassa trout," as he termed it was observed to attempt ascent of the inlets in company with the common trout.

During the search for other spawning grounds of white trout on Oct. 18, 1910, two individuals, of one-half and 1¼ pounds, respectively, were taken in gill nets set near the mouth of Pike Brook, and on Oct. 8 and 9, 1911, a pair, male 4 and female 5¼ pounds, was caught in gill nets sunk to the bottom in about 30 feet of water, in Blodgetts Cove not very remote from the brook.

[b] In Forest and Stream of Dec. 18, 1890, quoting Commissioner Hodge, Dr. Bean says: "The golden trout have sometimes come on the spawning shoals by the ton at a time. They do not pair to any noticeable extent, and a female is sometimes attended by five and six males. They make no nest, but move around continuously like lake trout. The lake trout voids the eggs by rubbing the belly over the coarse rocks, and the males sometimes lean down on top of the females. At Loon Island shoals the fish have spawned in waters so shallow that their backs were not covered. The usual depth ranges from 6 inches to 4 or 5 feet, but some of the large ones doubtless spawn in deep water."

A female is stated to average about 1,200 ova to the pound of fish. From fish-cultural operations it is observable that the eggs are not always deposited at once, more than one and sometimes several strippings being required to get all of the eggs. While this may possibly be due to the abnormal conditions incident to their retention in live cars, it is probably a natural condition.

It is stated that white trout have been taken weighing as high as 8 and even 10 pounds, but the largest of authentic record known to the writer was 7 pounds. The average size of those taken by the Bureau fish culturists in the fall of 1911 is estimated to be about 1 pound, but there were some much larger and many considerably smaller than this.

It is not known how long after hatching the young remain upon the shoal, but in summer young white trout of only a few inches in length are taken on the same grounds with the large fish.

Culture.—In the reports of the State commissioners no comments are made regarding the spawning of white trout until the report of 1889, where it is stated that 200,000 were planted in May and June, and "the aureolus were late in coming on their spawning beds; still a fair number were taken, considering the weather." The report for 1890 says that the fish came on their spawning grounds early in October and that 100,000 eggs were taken. The report for 1891 says: "The aureolus came on their spawning beds in October in large numbers and many more were secured than last year." The report for 1893 has the following: "Of the aureolus more than twice the number were taken [than last year], 148 having been procured in one day. Owing to the fact that a large percentage were male fish, the amount of spawn taken was but little over twice that laid down last year, being 105,000 last year and 218,000 this year."

The succeeding reports state in tables the number of fish planted and distributed. From these reports it appears that the State commission took the first white trout eggs in the fall of 1887 and made the first plant, as previously mentioned, in 1888. The State commission operated at Sunapee Lake until about 1900, and in that time planted 985,000 fry. In 1902 the United States Bureau of Fisheries assumed the work as a field station. The first plant was made by the Bureau in 1903, and the operations were continued until 1911. The detailed lists of distribution in the reports of the Bureau show that in this time 1,079,873 young white trout, mostly fry, were planted in the lake. There are several years of which the State reports give no records, presumably because no fish were planted.

The table following shows the plants of fry in each year by the State and Federal hatcheries.

BY NEW HAMPSHIRE.	
1888	200,000
1889	250,000
1891	70,000
1892	105,000
1894	200,000
1897	70,000
1898	90,000
Total	985,000

BY BUREAU OF FISHERIES.	
1903	[a]21,025
1904	16,000
1905	157,499
1906	213,163
1908	191,736
1909	229,736
1910	171,029
1911	79,685
Total	1,079,873

In 1890, 90,000 were planted by the State in other waters but none in Sunapee. The total number planted in Sunapee Lake from 1888 to 1911, inclusive, according to these figures, is 2,064,873.

The records of Mr. James D. De Rocher, of the United States Fisheries station at Nashua, who has been in charge of the Sunapee Lake field station since 1904, show the catches of white trout in each year as indicated in the following table:

CATCHES OF WHITE TROUT IN SUNAPEE LAKE.

Year.	Total trout.	Males.	Females.	Eggs taken.
1904	360	207	153	275,000
1905	721	461	260	349,800
1906	770	500	270	374,400
1907	614	395	219	290,786
1908	655	390	265	372,084
1909	374	164	210	302,050
1910	300	171	129	195,650
1911	706	416	290	370,300
Total	4,500	2,704	1,796	2,530,070

It is variously claimed and disclaimed that the white trout are increasing in number. There was a great falling off in the catch of 1904 over previous catches by the State commission, but this may have been due to imperfect or incomplete methods of catching them, or bad weather. In 1905 the catch about doubled that of the year before. In 1906 there was an increase of 49. In 1907 it fell off 56, but rose again in 1908 by an increase of 41 over 1907. In 1909 it dropped again to 281 less than the year before and in 1910 to 74 less than 1909, but 1911 brought it up to within 64 of the 1906 catch, the largest of the eight years. Yet there was a vacillating decline from 1906. The increase in 1911 was encouraging, as it possibly indicates an increase that may be maintained. But if the fish are increasing in numbers they are decreasing in size. It is only necessary to refer to the commissioners' reports of the early status of this fish in Sunapee Lake and compare it with Mr. De Rocher's statement, supported by his records, to substantiate this view.

[a] Includes 4,200 fingerlings.

Mr. De Rocher states that when he first took up his work there the fish would run 2 and 3 pounds on the average and larger ones up to 7 pounds were often caught, but now they do not average over $1\frac{1}{4}$ pounds, although some larger ones are still taken.

An increase in numbers is possible through the larger numbers planted and the decrease in the number of landlocked salmon. But the chinook salmon is a menace. A number of instances are reported where small white trout have been found in chinooks' stomachs. That this salmon has had no very apparent effect upon the trout is probably due to the comparatively recent increase in numbers and size of the chinook. The writer ventures to predict that if the chinook continues to increase in numbers the white trout will again decrease. The same may be said of an increase in the number of landlocked salmon. This has been discussed in another place and need not be repeated here.

Characteristics.—All of the saibling group are readily distinguished superficially from the common or "native" trout by the absence of rivulation on the back and usually by the more slender form. The common trout at all ages possess the rivulations. The presence of basibranchial or so-called "hyoid" teeth also is a distinguishing characteristic in New England, but farther north, as in Labrador, a fish supposed to be *S. fontinalis*, having the rivulations or wavy bars on the dorsal and caudal fins, at least has been found to have teeth on the "root of the tongue" or basibranchials. This is the case with the type specimens of *S. hudsonicus*, and this form (*S. hudsonicus* Suckley or perhaps more correctly *S. canadensis* Hamilton Smith) on that account, perhaps, should stand as a good species or, if intergradations are found, at least as a subspecies.

While it is comparatively easy to distinguish the common trout from the saiblings, it is rather a difficult matter to distinguish the species of the group. If they were not so closely related, it would have been easy to decide whether the Sunapee white trout was a Rangeley blueback or not. Dr. Bean distinguished *Salvelinus aureolus* from *S. oquassa* by the following differences:

SUNAPEE TROUT.	BLUEBACK.
1. Anal III, 8	Anal III, 10.
2. Immature 9 inches in length	Mature 9 inches in length.
3. Color of back in young, numerous dark blotches	Back uniform steel blue.
4. Embryo with white lines at the upper and lower edges of caudal.	No such white lines.
5. Spawns in lake on shoals	Spawns in streams.
6. Gill rakers shorter and usually less numerous and almost always curled.	More numerous and not curled.

The first difference will not serve to distinguish, as *S. aureolus* sometimes has 10 anal rays, but in general it is of significance, especially

when taken with other apparent differences, that the usual anal-fin formula in *S. aureolus* is 9, that of *S. oquassa* 10 or 11.

The second distinction does not now obtain, for mature 9-inch *aureolus* have been observed and *oquassa* is known to reach the size of the average *aureolus*.

The third is of no value, as it is comparing an immature or young fish with a mature adult.

The fourth is of little value, as it refers to a character that was observed in *S. aureolus*, but its absence in *S. oquassa* was conjectured.

Fifth. The place of spawning is obviously not a specific distinction.

Sixth. The gill rakers of the large specimens of *S. oquassa* do not differ in number, length, or in curling and other distortions from the Sunapee white trout.

Having weighed and found most of these supposed differences wanting, it remains to point out the real differences, if any exist. The most conspicuous external difference is of color, and that is not very pronounced. The spots are more numerous and smaller, and the under side of the pectoral fin has a narrow margin of white in *oquassa*. While, as before stated, the *oquassa* occasionally has as few as 9 rays in the anal, it more often has 10 or 11, and *aureolus* never has been found to have 11, and only rarely 10. Comparing two male specimens each of the two species, the *oquassa* apparently has a somewhat longer head and snout. More careful examination of a larger number of specimens each might either reveal more differences or reduce the foregoing to naught. The young, even in the fry stage, are usually easily distinguished from the common trout by fewer parr marks.

Propagation.—The European saibling has been successfully cultivated for many years, and judging from the experience in hatcheries in Maine, as related by Mr. Merrill in a letter to Dr. Quackenbos,[a] the young of the white trout could be easily reared to yearlings, if desired, in artificial inclosures. Mr. Merrill states:

> At Green Lake the temperature of the water runs high in the spring, and much loss has been occasioned thereby among the brook trout fry, but the saibling have in such cases remained perfectly healthy. My experience in rearing this fish has been extremely satisfactory, and I believe it to be one of the best subjects for the fish culturist among our Salmonidæ, especially where the fry are reared to the yearling stage, as is generally done in Maine. The eggs that I received last winter hatched well, and the fry in the early stages of development displayed wonderful hardiness under the most trying circumstances.
>
> The brook trout during the spring suffered from warm water, the temperature rising to 65° F. soon after they hatched. The loss was considerable, but the saibling fry were not affected by this high temperature. * * *

[a] "The American Saibling," etc. Second Annual Report of the Commissioners of Fisheries, Game and Forests of New York for 1896, p. 185–191.

WHITE TROUT. BREEDING FEMALE.

In consideration of the experience which I have had with the American saibling, I would select it in preference to any other fish if I desired a salmonoid to rear from fry and obtain the best results in size and percentage matured.

Grayling (*Thymallus montanus*).

The Montana grayling originally existed only in the tributaries of the Missouri River above Grand Falls. The United States Bureau of Fisheries first began successful propagation of the grayling in 1897, at Bozeman, Mont., under the superintendency of Dr. James A. Henshall. It was at the Bozeman station that the grayling planted in Sunapee waters originated. The habits of this grayling are described by Dr. Henshall as follows:

> The Montana grayling prefers swift, clear streams of pure water, with gravelly or sandy bottom. It is quite gregarious, lying in schools in the deeper pools, in plain sight, and not, like the trout, concealed under bushes or overhanging banks. In search of food, which consists principally of insects and their larvæ, it occasionally extends its range to streams strewn with bowlders and broken rocks. The fry subsist on minute crustaceans, as *Entomostraca*, and for seizing the minute organisms is furnished, like the lake whitefish fry, with two sharp retrorse teeth in the upper jaw.

The grayling spawns on gravelly shallows, and Dr. Henshall says that it will go long distances, if necessary, to find suitable spawning grounds, even passing through large lakes to the inlets.

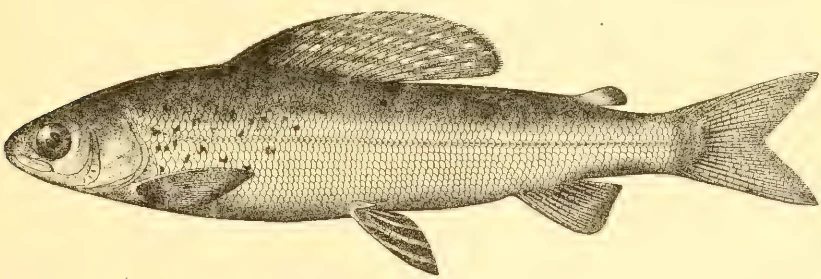

Fig. 3.—Grayling.

Regarding its game and food qualities, Henshall is quoted as follows:

> The Montana grayling is a most graceful and beautiful fish, whose dainty and lovely proportions and exquisite coloration must be viewed fresh from its native waters to be appreciated properly. As a food fish it is fully as good as the trout, and to my taste better. Its flesh is firm and flaky, very white, and of a delicate flavor, as might be expected. As a game fish it is the equal of its congener, the red-throat trout, and when hooked breaks water repeatedly in its efforts to escape, which the trout seldom does. It takes the artificial fly eagerly, and if resisted at the first cast will rise again and again from the depths of the pool, whereas the trout will seldom rise the second time to the same fly without a rest.

The United States Bureau of Fisheries reports of the distribution of fishes show that the following plants of grayling were made in Sunapee

waters: In the tributaries of Sugar River, in 1904, 10,000; in 1906, in Sunapee Lake, 15,000; and again in Sunapee Lake, in 1907, 40,000, aggregating 65,000. There is no evidence that these plants were successful.

Sunapee Lake and Sugar River are surely not suitable waters for the fish, according to Dr. Henshall's statement regarding its requirements. The conditions of the tributaries of Sugar River referred to are not known to the writer. Should the grayling become acclimated in these waters, it could hardly do any harm, as it is mainly an insect feeder, and does not attain a large size.

Smelt (*Osmerus mordax*).

The common smelt is primarily an anadromous marine fish, the geographical range of which is from Labrador south at least to New Jersey, and it has been recorded from the Delaware.

It abundantly ascends the St. Lawrence River, the rivers of New Brunswick, Nova Scotia, Maine, and New Hampshire, to some extent the streams of Massachusetts, Rhode Island, Connecticut, New York, and formerly New Jersey, especially in the latter State the Raritan and Passaic Rivers. Even now brooks of Long Island are said to be frequented by smelt.

The smelt is of considerable commercial importance throughout its present geographical distribution, as caught in traps, weirs, seines, and in the winter through the ice with hook and line. Throughout its range, at least as far southward as Massachusetts, it has become landlocked; that is, in times past, some have remained in fresh-water lakes and ponds and formed a fresh-water race, which in breeding time continues its anadromous habit of ascending tributary streams whenever possible, from its fresh-water sea. In a few ponds, however, it spawns along the shores among the sedges and water plants. It has even been claimed that smelt eggs have been obtained from deep water, attached to sticks. This, however, is probably due to a mistaken identification of the objects.

Fresh-water races.—In many lakes there are apparently two distinct races of smelts, which possibly may be distinct species. In fact, the fresh-water smelt may be specifically or subspecifically distinct from the marine form, or there may be many distinct species in fresh waters, as a number of lakes produce smelts which, in the absence of sufficient material examined, seem to differ from the smelts of other fresh waters. Cope long ago described two Maine lake forms as distinct species, which have since been recognized in the books as subspecies of the marine smelt. But the differences are sufficient to constitute distinct species, at least until intergrading forms have been discovered.

Therefore it is possible that the fresh-water smelts should all be considered one or the other of Cope's species; but inasmuch as one of

these, at least, differs from some other fresh-water smelts as much as it does from the marine smelt, it seems more likely to confuse than to clear up the matter to transfer and apply names indiscriminately without sufficient data upon which to base conclusions.

The two apparent fresh-water races, previously alluded to, may be only apparent on account of this same lack of knowledge. The apparent differences are those principally of size and habits and to some extent structure, so far as examination of specimens has proceeded. In a number of Maine lakes there are (apparently) two distinct sizes, with somewhat different breeding and feeding habits. One size reaches a length of at least 15 inches and a weight of a pound, and even larger ones have been reported. The smaller one existing in the same lake seems not to reach a larger size than 5 or 6 inches at most, as indicated by those constituting the breeding runs in the streams. The time of spawning differs more or less. The height of the period of the larger form being at least a month earlier than the smaller one. The smaller one usually ascends the streams as soon as they are free from ice, or a little later. The larger one is known to ascend them, in some localities at least, before the ice is out.

In those lakes where there is apparently such an extreme difference in size, only the larger form is caught with hook and line in summer and through the ice in winter, this being due to the difference in feeding habits, the large smelt subsisting mainly upon smaller fish, for the most part young smelts and the smaller form. The small smelt subsists, so far as at present ascertained, almost wholly upon minute crustaceans. This characteristic feeding habit obtains, however, only where the two apparently widely distinct forms exist, as in some lakes, Sunapee for instance, even little smelts only 4 or 4½ inches long are taken on worm and fish bait.

Then, again, there are lakes and ponds where the two distinct sizes do not seem to exist and the smelts are of practically a uniform size in the one pond, differing in size variously from those of other ponds, according to the pond; and some of the ponds are closely connected with lakes in which the two sizes exist, others are far remote from other ponds with smelts.

Some of the large and deep lakes contain only tiny, transparent smelts, sexually mature when only 2 or 2½ inches long; while in a neighboring body of water, at least within the same county, a much smaller pond contains smelts 6 or 8 inches long. Also there is an instance of a very large lake containing the two apparent extreme sizes, with a tributary pond, the connecting stream of which is not over one-half mile long but at present obstructed by a dam, in which the smelts are uniformly of from 2 to 3 inches in length and sexually mature. Thus it appears that the smelt question is at present a very puzzling one, especially regarding their specific identity, and they

afford a good example of the importance to fish culture of accurate classification. If the large smelts are specifically distinct from the small ones, and will attain a large size wherever successfully introduced, and the small ones, when transferred to any larger lake, or one of more suitable conditions for growth, do not attain a large size, the purpose of the transplanting will decide which form to select and propagate. If the fish is desired as a commercial food fish, without regard to the possible consequences to other fishes, the large form should be chosen. If a food supply for Salmonidæ or other game and food fishes is desired, the small form would be the proper one.

It may be said, however, that further investigation may show that all of these differences of sizes, feeding, and breeding are simply due to the peculiar conditions of the lake in which the smelts occur, and that the young of the large form planted in one body of water might not attain to more than the transparent 2 or 3 inch size, and the young of the latter size transplanted into another lake might reach the 12 to 15 inch size. There are a few instances of smelt occurrence that tend to support this. One large lake in Maine containing the two extreme sizes of 4 to 6 inches and from 10 to 15 inches in length has two tributary bodies of water in which smelts occur. In one, previously mentioned, a pond of an area of something over 1 square mile and a greatest depth of 30 or 40 feet, the smelts are not over 3 inches in length, and in the other, a much larger and deeper pond, receiving the waters of two other large ponds, there are again two sizes of smelts, the larger size, however, not growing as large as in the main lake. The smelts in these two tributary waters, on the theory that the fresh-water smelts are derived from the marine form and not vice versa, doubtless originated in the smelt of the main lake, which itself originated in the smelt that ascended from the sea. Yet, in the absence of positive knowledge, it is best to regard the foregoing apparent conditions and attendant possibilities in the propagation and transplanting of smelts.

The only waters in New Hampshire of which there is record of indigenous fresh-water smelt are Winnepesaukee and its connected waters. From these waters the smelt has been successfully introduced into various other New Hampshire lakes and ponds. It is stated regarding the smelt of these original waters that this peculiar condition exists: namely, while in Winnepesaukee itself the smelt is seldom over 4 inches long, in the tributary smaller ponds it attains a length of 6 or 7 inches or more.

Habits.—The fresh-water smelt in the summer months affect rather deep water, or cool water, which in the larger lakes varies in depth from 60 to 100 feet or such a matter. It does not thrive

in shallower ponds unless the water is cool enough for them, but is known to occur in ponds not over 30 or 40 feet in depth.

As has already been stated, the food of the smelt varies according to the size of the fish, and it may be added, according to age. Its strong sharp teeth on the jaws and tongue indicate its carnivorous propensities, while its comparatively close-set gillrakers suggest rather minute planktonic food at certain stages of its growth at least.

The young subsist largely upon animalcules, such as minute crustaceans which usually abound in most fresh waters. The larger smelts appear to eat small fish and principally their own young, excepting in the smaller sizes of adults previously referred to.

While the smelt inhabits the deeper, cooler waters most of the year, it occasionally comes to the surface on calm cloudy days or in the edge of the evening and moves about in various sized schools, often with noses out of the water, frequently leaping from the water or rolling out porpoise-like. So far as has been observed, however, it is only the young and smaller sizes that do this. The significance of this habit is not known. It may be, as suggested by the size of the fish, for feeding, as it is under just such conditions as exist when smelts school that minute Crustacea, etc., are particularly abundant at the surface.

The writer never observed smelts in Sunapee Lake schooling at the surface in this way and could not learn that others had observed them. The fact that, as previously mentioned, Sunapee Lake smelts, even the smallest adult sizes, take a baited hook, suggested that adult smelts, although small, did not feed exclusively upon such fine objects, but fish ranging from a little over 1 inch to a little over 5 inches in length, taken in Sunapee Lake, were found to subsist largely upon *Entomostraca*, although some insects were found and in two instances smelt eggs. The latter are referred to on another page. As was to be expected, the fish taken at spawning time did not contain so much food as later in the season.

Every spring after the ice leaves the lake and the freshets in the brooks have subsided the smelts usually begin to ascend the streams to spawn. The "run" is as a rule by night, although on exceptionally dark days a "run" of smelts has been known to occur. They ascend the streams to various distances from the mouth, and the spawn is deposited upon and adheres to stones, sand, moss, sticks or any other object with which it comes in contact. As before stated, the large smelts, where the "two sizes" exist, run first, and in lakes there the sizes vary, but have no distinct line of demarcation, the larger ones are said to run first and usually the majority of the first runs are males.

The male fish is easily distinguished from the female even in the dark, by touch, when first removed from the water, being profusely covered with tiny tubercles, which feel much like fine sand.

In 1910 the first run of smelts occurred in Pike Brook on the night of April 13. The runs continued to increase in numbers of fish until the 19th, on which night the smelts fairly swarmed in the brook. The runs continued constantly large until the 25th, when they rapidly decreased in numbers until the night of April 30, when only a few stragglers were observed in the brook. After April 21 those remaining in the pools decreased in numbers. For sometime, however, the brook was so high and roily that had there been smelts there they could not have been seen. Subsequently the only smelts observed during the daytime were not over a dozen in each of the two pools mentioned on the 22d and 23d, only one smelt on the 24th, and a small school in the hatchery pool on the 25th.

It has been generally supposed that smelts invariably return to the lake on the night of their ascent, after spawning. The writer's observations on the marine smelt in small coastwise brooks revealed that, when undisturbed during the night, large numbers, if not all, remained in the brook the next day, and often some smelts lingered in the brooks long after the spawning season was over, becoming emaciated and weak. Those remaining after the spawning season, so far as examined, always proved to be males. These facts led to the suspicion that possibly fresh-water smelts might have a similar habit; and at Sunapee Lake it was found to be a fact that if the smelts were undisturbed during the night before, the next day large numbers were found along Pike Brook as far up as they could ascend, but mostly congregated in the deeper pools. On April 16, 1910, notwithstanding the fact that there was some "dipping" during the first of the night before at the mouth of the brook, schools of smelts were found all along the brook, from just below the hatchery up 200 or 300 yards, in every little pool, and the same conditions obtained on the 17th. On the 20th smelts were observed in the pools, but there were not as many as could have been expected from the run of the night before. After the 20th no large numbers were observed during the day, but groups of a few or individuals here and there were sometimes seen.

It was observed that they, sometimes at least, begin to feed before descending to the lake. On April 20, in a large deep pool, some smelts appeared to be feeding, moving moderately here and there as though picking up or looking for something floating in the water. In the afternoon the writer, using a tiny hook with a small piece of earthworm for bait, caught six of the smelts, which proved to be spent or partly spent males, still having rather large milts. Two were 4, one $4\frac{1}{4}$, two $4\frac{1}{2}$, and one $4\frac{5}{8}$ inches in length. There were many more bites, but

the fish could not be hooked. Some of the fish would come up to the bait slowly, open their mouths and take it in; some would dart at it quite smartly; some would not notice it unless it were moving rapidly; and some would pay no attention to it whatever. The latter were the larger smelts. The stomachs of three of the larger fish caught contained smelt eggs and several insect larvæ, apparently mosquito.

The spawning period varies from three to six weeks at Sunapee, lasting on an average not over a month at most. The runs gradually increase in numbers of smelts to the height or middle of the season, then rapidly decrease in number of individuals. No smelts were actually seen leaving the brooks until April 18, when some were reported to be drifting tail first out of the mouth of King Hill Brook at 8.30 p. m. It is possible that they were really an in-run that settled back toward the lake upon the approach of the observer. On April 24, well up Pike Brook, at 9.30 p. m., a good many smelts were evidently running downstream head first, but at the mouth smelts were streaming in in large numbers. At no other times, however, were any seen actually descending the brook, although a decreasing number was observed in the brook each successive day until May 1. But there was plenty of time in which they could have migrated unobserved.

After the spawning period for some days, even weeks, many dead and dying smelts are found at the surface and washed on the beach, bearing no lesions or marks of injury. It was formerly thought that perhaps it was due to the exhaustion and starvation of the spawning period, which causes them to succumb to slight changes of temperature, or inability to obtain sufficient food soon enough to enable them to recuperate. But throughout the season more or less dead of various sizes and ages are found washed up on the beaches. At Sunapee Lake some dead and dying adult fish, ranging in length from $3\frac{1}{4}$ to 7 inches, were observed near the mouths of brooks during the spawning season. Such fish, however, did not occur there in such large numbers as have been observed in other waters during and following the spawning, and young and adults were found throughout the seasons of 1910 and 1911.

Seldom were any lesions observable and those at any time present were usually a congestion about the vent, which was occasionally accompanied by a growth of fungus in the same place. This condition was rendered insignificant as a result of the spawning function alone, as a number were found in October in a like condition. That the death at spawning time was only coincident was indicated by the finding of several of them that were not quite ripe and some ripe fish that had not been into the brooks; and young or yearling fish, $2\frac{1}{4}$ to 3 inches long, were also found at the beginning of the spawning season.

A few instances of dead fish that had evidently been in the brook were noted. They were spent, and their stomachs contained smelt eggs besides insects. This fact indicates that the death, even at spawning time, perhaps could not be ascribed to weakness from starvation, especially when the dead and dying fish that had not entered the brook were found to contain some food.

The dead and dying fish picked up on the beaches were more numerous during the spring and fall than in the summer. This may be due to the fact that smelts reside mostly in deep water during the warmer months, and though they die in those months they would be quickly snapped up by trout and salmon. It may indicate that in the fall, as the water becomes cooler, the fish approach the surface and perhaps the shore, as indicated by the presence of insects in the stomachs of those examined.

The presence of dead smelts along the beaches could not be connected with any sudden change of temperature, although they usually and most abundantly appeared during or shortly after strong winds. The latter probably accounts only for their being washed up, although possibly smelts swimming in shallow water might be washed up and thus killed by the heavy seas raised by the strong winds. But this would not account for those found when there had been no strong winds. Intestinal parasites were found in many but not all of the October smelts examined, but this partial freedom from parasites seems to eliminate them as a factor in the mortality.

Therefore, the cause of death of so many smelts throughout the season is as yet unsolved. After all, those found dead on the shores or floating at the surface are few compared with the multitudes that live in the lake, and it is perhaps quite natural that there should be deaths due to obscure causes, as among higher animals.

Efforts were made night and day to ascertain if there were any peculiar habits or movements connected with the spawning. The following is a detailed account of the observations made:

The first observations were made on the night of April 15, 1910, when smelts were found making their way some distance above the mouth of the brook at the outer edge of the beach. After reaching the head of the channel they seemed to have some hesitation about entering the dead water above, swimming back for a short distance several times before going in. But this action may have been due wholly or in part to the lantern or the writer standing near the place. Whenever startled by anyone approaching the brook they would run down a short distance, but when "dipped" at with nets they strove to get upstream even in the face of much splashing of the water with the feet while standing in the brook.

During the day of April 16, in one pool the smelts occupied an eddy between two currents, circling about in the eddy, but not heading in

definite order, sometimes downstream, sometimes up, and sometimes crosswise, and often some heading in one direction and some in another. In another pool above this a school occupied an eddy, swimming about irregularly and slowly to some extent, and generally rather stationary or drifting irregularly, but with their heads generally toward the slow return current at almost right angles to the bank.

In another pool a school started by the writer's step on the bank darted downstream as far as a shoal ripple, then slowly returned with heads all directed upstream, some smelts above others, but all in the same direction. The smelts when undisturbed did not all occupy the same level in the water; some were near bottom and some farther up in the water, even at times near the surface, but they were all the time rising and settling again, swimming back and forth individually and to some extent collectively but irregularly in the latter case. There was no evidence that they were at this time spawning. In the first pool mentioned a few eggs were seen attached to dead leaves, moss, and sticks, but they were white and may have been extruded when the fish were disturbed the previous night by dipping. Further observations show that the smelts very slowly moved about in the eddy in a comparatively large "circle" or rather ellipse, but in a very irregular manner.

Two smelts, one large and the other small, were seen to come rather quickly to the surface together, breaking water with their backs. Probably this was not significant, as no more were seen to do it, or anything like it, during a long watch. No evidence of pairing was observed.

Later in another place a small school of smelts was seen lying at the foot of a pool in which was considerable current. They were comparatively motionless, just above a shallow ripple, heads all upstream, merely drifting from side to side, when with one or two quick flirts of the tail they kept themselves from going backward. They scarcely moved upstream at all at any time, and when there was such a movement it was only on the part of one or two of them, not the whole school.

At 9 p. m. the smelts had mostly gone out of the deep holes and were scattered along the brook, generally on the ripples, but on the morning of April 17 the schools were all in the deep holes where they were seen during the day before.

On the night of April 18 the writer observed some smelts in the brook by the hatchery that were evidently spawning, making no attempt to go farther up the brook. There were, however, others above and some running up by them. Those watched were in shallow water on sand, fine gravel, and pebbles and headed upstream where the current ran quickest, but nearer shore they would lie on the bottom with their heads in no particular direction. Sometimes

they were so near shore that their backs were nearly out of water. There were some rather quick movements made by those in quick water, but evidently for the purpose of maintaining their position where they were swinging from side to side but not going forward, sometimes, however, turning and running down or to one side a short distance. But those in the still water lay comparatively quiet, some of them actually resting on the bottom, but they all moved about to a slight degree.

On the night of April 19 further observations were made on the smelts that fairly swarmed in Pike Brook. They did not seem to be disturbed by lantern light but, of course, it is possible that their movements may have been more or less modified by it. No very peculiar movements were observed. There appeared to be no pairing, each fish lying by itself, quietly on the bottom, slightly on its side in a sort of curve. Sometimes one would lie near another and occasionally one would dart forward under the edge of a partly submerged sod.

During the day of the 20th the smelts were all in pools, usually stationary with heads pointed upstream, occasionally swimming a little and now and then turning to one side or downstream.

During the day of the 22d a fair-sized school was seen in the pool by the hatchery, but there was none in the deep pool where they were caught with hook. There were three or four "scattering" smelts in other places. In the night the fish were scattered mostly in shallow and quick water. Some that were probably spawning were observed. There was one group of 8 or 10 or more individuals side by side and before and behind, in rather quick water, neither going forward or backward, but swinging back and forth with the current like a bunch of moss, those ahead with a slighter motion than those farther behind. A few others in pairs, or single, were in stiller, shallow water apparently spawning, moving about slightly but usually with head upstream. There was some current here. They seemed to some extent to lie on their sides, and they moved up into shallower water until their noses were out of water on the gravel. One fish got on top of a stone with half of its body out of water and stayed there some time without seeming to mind it. There seemed to be no contact of bodies except apparently accidentally or incident to the swinging or waving in the current. On the other side of the brook on a rather steep slope of sand and clay bank in shallow water, quite a number were seen likewise stationary. Their movements were similar to the others just previously mentioned. No lantern was used in watching the first two lots mentioned. While the smelts mentioned remained stationary, many others were shooting up, over, and among them on their way up the brook.

There was a good run on April 23. At 8 p. m. some up under the overhanging bank on a steep shelving bottom were watched. Their heads were upstream and they were swinging or waving from side to side, their bodies occasionally, perhaps, brushing against a neighbor, but no other contact was noticed and apparently no pairing or any approach to it took place.

The smelts constituting the run of the night of April 13 were said to be "large" fish, but most of those of April 15, as shown by measurement of over 100, ranged from 4¼ to 5 inches, and there was only one of the latter length. Those taken on the night of April 17 ranged from 4¼ to 8½, although the majority were from 4¼ to 5 inches in length. While the larger fish were always present, the proportion was somewhat smaller toward the last of the season. This, taken with the fact that in the first runs male fish predominate, was thought to indicate that the male averages somewhat larger than the female, although occasionally a female as long as 8½ inches was observed. The following table shows that males continue to predominate during their breeding season and that the smallest fish caught was a male and the largest a female.

Table Showing Proportion of Male and Female Smelts and Range in Size of Each Sex.

Date.	Total examined.	Males.	Females.	Size of males.	Size of females.
				Inches.	*Inches.*
Apr. 18	493	465	28	4 –7	4 –7
18	871	771	100	4 –7	4 –8½
19	1,336	1,000	336	3½–7¼	4 –8
24	213	186	27	3⅜–5⅝	3½–4⅜

The smelt is very prolific, an individual 4⅝ inches long carrying 5,893 eggs, as ascertained by actual count. Doubtless some eggs escape fertilization, but the countless numbers of "eyed eggs" observed clinging to moss indicated that the yield of the spring of 1910 in Pike Brook alone would be a large one. The period of incubation appears to be short, the eggs hatching in from 10 to 15 days, according to the temperature of the water. The young are tender, threadlike creatures, but grow rapidly and enter the lake at an early age.

Enemies.—The smelt is not free from enemies even in the brook, where large predaceous fishes can not enter, but there, aside from man, by far the most destructive are minks, sheldrakes, kingfishers, trout, and chubs, all of which were at times observed at Pike Brook in April, 1910. The birds and minks take the adult smelt, as does the trout to some extent, but the trout and chub feed mainly upon the eggs and young, and, as has been shown, the smelt is not averse to its own eggs.

The smelt is a delicious pan fish and even the smallest fried whole, in the manner of whitebait, are highly esteemed. It is the natural food of the landlocked salmon, and the salmon thrives only where there are smelts.

Effects upon fishing for other fish.—It has been claimed that where smelts abound the fishing is greatly interfered with; the fish will not take the fly and rarely any other bait than live smelt.

In a letter received by Mr. John W. Titcomb, then fish commissioner of Vermont, and published in Forest and Stream of June 27, 1896, the poor fishing of the preceding May at Sunapee Lake was ascribed to the smelt. Among other things the letter stated that where smelts occur a piece of maple sugar for bait would be almost as effective as any fish other than smelt, and goes on to say:

> There is no doubt but that the smelt is great food, but if it spoils the fishing with rod and tackle, where is its advantage? It certainly may ruin the fly fishing, as it no doubt does the bait fishing, to a very great extent. There is no fly fishing at Sunapee at all and the only way that it is accounted for there is the smelt.

Mr. Titcomb, commenting on the statement, wrote:

> It would be unreasonable to think of depriving a body of water of desirable fish food for the purpose of forcing a fish to rise to the surface to take flies or other artificial bait.

This is a very pertinent remark, for where there is not sufficient food the fish can hardly attain a size to make them worth catching. On another page it has been stated that where insects afford the only food supply trout do not grow very large.

It seems to be a peculiar trait of the mind of man, or at least of the minds of some men, to account for phenomena by the most prominent or conspicuous condition that may be a possible cause. In other words they jump at conclusions without sufficient verification.

If in any lake the water is high or low and the fishing good or poor, it is good or poor because the water is high or low, as the case may be. Good fishing or poor fishing in a lake abounding in or free from smelts is ascribed to the abundance or lack of food supply, and those persons have in mind the one body of water and the immediate conditions obtaining there to base their conclusions upon.

Smelts abound in Sebago Lake, Me., and they are apparently just as abundant one year as another, but the fishing varies; one year or at one portion of the season the fishing is good, at another bad. Which is the smelt accountable for? In Sunapee Lake also there have been seasons of good fishing, notwithstanding the smelts, and there were times of poor fishing before Sunapee knew the smelt, if the reports of the State commissioners can be trusted.

As for fly fishing being ruined by the abundance of smelts or other food supply, other waters where the smelts abound and where fly

fishing is unexcelled need only be cited to controvert the contention. One of these is Grand Lake, in the western St. Croix waters. In any body of water one principal reason that fish are not taken on the fly is that they are not fished for with the fly. Notwithstanding the prevalent opinion that salmon never take the fly in Sebago Lake owing to the smelt, whenever anyone has persistently fished with a fly salmon have been caught by that means, and one usually has to persistently fish by any method to land many fish. Furthermore, the writer has examined hundreds of Sebago salmon, and while the majority, when they contained any food at all, have smelt in their stomach, many have been found having insects only, and some containing both insects and smelts or some other fish.

These remarks apply mainly to the landlocked salmon and it may be added that the writer has still-fished for smelts and salmon on the same "ground" and used live smelt, live shiners, and pieces of smelt for bait for salmon, and has caught just as many on shiners as on smelt and nearly as many on the cut bait as on the live bait. The scarcity of "native trout" in Sunapee easily accounts for the poor fishing with bait or fly.

While the white trout has been taken on the fly, it is primarily a deep-water fish and is taken mainly by bait. But in the way of bait it does not seem to prefer smelts to some other bait. In Floods Pond in Maine, where there are plenty of smelts, a small piece of fresh uncooked lobster is an unexcelled bait.

Apropos the scarcity of native trout and the growing scarcity of white trout, it might be well to say that which is suggested elsewhere in this report, that had not Dr. Fletcher in his (or some one's else) wisdom planted smelts in Sunapee Lake, the trout would have disappeared before the salmon long ago, and the salmon would not have lasted as long as they have.

Smelts were first introduced into Sunapee Lake by Dr. Fletcher in the spring of 1870. These, 700 in all, were obtained in Winnepesaukee or a tributary lake. Another plant of 1,000 was made in 1872, but it is not stated from what water they were obtained. The New Hampshire Fish Commissioner's report for this year states that several smelts were caught that spring in a brook running into Sunapee Lake, where they were introduced two years before, and in the report for 1873 it is said that smelts were seen in the streams running into the same lake, "attending to their propagating duties." In two years the smelts manifested themselves in the brooks and the next year were there in apparently increased numbers. In 40 years they fairly swarmed in the lake; in fact, they have abounded there for years. While the adult smelt easily succumbs, its eggs are hardy, especially after they are "eyed," and may, with reasonable care, be transported long distances.

SUNFISH (*Lepomis auritus*).

This is the fish commonly referred to at Sunapee Lake as "pumpkin seed," and it seems to be very abundant, though not attaining so large a size as it does in some waters. In its young stages it is to some extent eaten by black bass and other fishes occurring in the same localities with sunfish. In its adult size it is more or less destructive of other fishes, especially the young, occurring in the same localities, but it is mainly an insect feeder, and for that reason does little harm.

In some parts of the country large sunfish of this species are considered as food fish, but owing to their small size in Sunapee Lake they are not often used for that purpose.

Throughout the summer and fall hundreds of various sizes could be seen about the steamer wharf at Blodgetts Landing, in company with some small black bass.

PUMPKIN SEED (*Lepomis gibbosus*).

The fish was not observed by the writer in any of the Sunapee waters. It is included in the list on the authority of Hon. Nathaniel Wentworth, who says it occurs in Sunapee Lake.

This species is more properly the pumpkin seed than the preceding. It may be distinguished from the other by its always shorter and red-margined black gill flap, smaller mouth, and 4 rows of scales on the cheeks instead of 7 as in the other.

BLACK BASS (*Micropterus dolomieu*).

The black bass is a member of the sunfish family to which the previously mentioned sunfish and pumpkin seed belong. It is therefore not a bass. The only importance attached to this fact, so far as Sunapee Lake and its fish and fishing are concerned, is that it accordingly has not the habits of a bass. True basses are voracious, marauding, devastating pirates. The white perch is one of them. The black bass, however, is a comparatively inoffensive citizen. It has its faults, and chief of these is that it sometimes, not infrequently, eats other fishes, but as will appear from quotations given later in this paper, this fault is sometimes a commendable one. The natural range of this species is given in the books as "from Lake Champlain to Manitoba and southward on both sides of the mountains from James River to South Carolina and Arkansas." It is justly held in high esteem by all anglers as a game fish and, with some exceptions, as a food fish.

Dr. James A. Henshall, the noted champion of the black bass, says of it:

> The black bass is eminently an American fish; he has the faculty of asserting himself and of making himself completely at home wherever placed. He is plucky, game,

brave, unyielding to the last, when hooked. He has the arrowy rush and vigor of a trout, the untiring strength and bold leap of a salmon, while he has a system of fighting tactics peculiarly his own. I consider him, inch for inch and pound for pound, the gamest fish that swims.

It is unnecessary to say anything more on these points. Every angler has views of his own regarding his favorite fish, and nothing can be said or written that will change his opinion.

Young bass subsist chiefly upon minute Crustacea and insects, and as they increase in size and age they feed upon worms, tadpoles, small fish, etc., and, as Dr. Henshall says, "In later life they vary their diet with crawfish, frogs, mussels, and water snakes, until, attaining a weight of 2 pounds, they will bolt anything from an angle worm to a young muskrat."

Under favorable conditions the black bass grows rapidly and in some waters has been known to attain a weight of 8 pounds and over. It also rapidly multiplies, so that in a few years, when suitable conditions exist, those waters into which it has been introduced have usually been completely stocked.

What effect the introduction and multiplication of the black bass in Sunapee Lake has had on the fishes and conditions of that lake is hard to say without knowing more definitely what the conditions were at and prior to the introduction.

The following quotations indicate that it has been a destructive agency at least so far as perch are concerned, and if destructive to perch why not other fishes as easily obtained?

The first black bass to be placed in Sunapee Lake were brought from Lake Champlain in 1867 or 1868. The State fish and game report for 1871 (June session) states that in the past year large numbers of young bass have been observed and many have been caught while fishing for other fish. It goes on to say that the people in that vicinity appear quite anxious to have the lake well stocked with bass.

The State report for 1872 states that many bass have been caught in Sunapee Lake.

The State report for 1873 says black bass are reported to be very numerous in Sunapee.

The report for 1874 says:

We found the bass quite plenty in Sunapee Lake last summer, and succeeded in catching over 400 with hook and lines for stocking purposes.

After speaking of the fish in other waters, the report for 1876 says:

But Lake Sunapee bears away the palm, its waters literally teeming with bass and affording splendid sport to the angler. As a hint toward their wonderful increase and abundance there, it may be stated that, stocked in 1868, in the season of 1875 it is estimated that 3 tons of black bass were taken from the lake.

On another page it states that in the first of the winter a black bass weighing over 4 pounds was caught through the ice.

The report of 1879 seems to indicate a revulsion of the former enthusiasm over the black bass. It says:

There is a very strong feeling in many parts of the State that our labors had better be confined to increasing our stock of native fish and restoring those once common to our waters, rather than to introduce new varieties of scaly foreigners who may do more harm than good. Black bass have only been partially a success, and from their rapid spread in the Merrimack and Connecticut Rivers may prove to be very detrimental to our efforts to restock those rivers with salmon and shad.

The report for 1881 says:

One of your commissioners, in going by Sunapee Lake last summer, on his way to Clairmont, at 5 o'clock p. m. saw a string of 47 pounds' weight put on the train by two gentlemen who had arrived there at 10 o'clock the same morning.

In the report of 1888 the commissioner shows cause why the black bass is a blessing to Sunapee Lake, in the following words:

Here I wish to say a word in favor of the much-abused and misunderstood black bass. Previous to the introduction of the black bass into Sunapee Lake it was not known as a trout lake except to a few in its immediate vicinity, and the catch of trout, with the exception of those netted and speared during the spawning season, was very small. The lake at that time was infested with large numbers of small yellow perch, which destroyed the young trout as soon as hatched. Especially is this true of the *Aurcolus*, they being lake spawners. The black bass have destroyed the perch, and their place is now taken by hundreds of the finest trout in the world. Here we have a lake noted for its excellent bass fishing, and at the same time one of the finest trout and salmon lakes in New England, and no fisherman on the lake has ever made complaint that the bass interfered with the trout in any way.

But again, in the report for 1900 (1901), the commissioners (different ones) say:

The bass have become so numerous in Sunapee Lake as to satisfy us, if not all, that protection should be taken from them for a time in those waters, and fishermen should be allowed to take them at all times, and of any size, until their numbers are so far reduced as to secure the comparative safety of other fish from their ravages.

A year ago last August, Commissioners Wentworth and Shurtlef spent two days at Sunapee experimenting on bass, and during that time we caught in deep water 8 to 10 bass, from the stomachs of which we took *Aureolus*, or white trout, and brook trout, which was to us an easy solution of the question which has been often asked, Why are there no more small brook trout in Sunapee?

In the report for 1889 the statement is made that "black-bass fishing was better in 1888 than it had been for a number of years."

In the report for 1904, after stating that in Sunapee Lake more large salmon were taken the last year than in any one year for 20 years, they continue:

In the last 12 years our commission has never planted black bass in waters that contained salmon or trout. There is no doubt that in Sunapee Lake, where they are very plenty, they have done much to retard the increase of both trout and salmon.

Lately the conviction seems to prevail among black-bass anglers that the fish is not only growing much scarcer, but that it seldom attains the size that it formerly did. The season of 1910 was very

poor in numbers and size of those caught. The fishing in 1912 was much better, but far below that of former years. Others maintained that the black bass was just as abundant and as unmitigated a nuisance as it ever was.

It is undoubtedly true that it is only occasionally that good catches of sizable bass are made, and that it is, as a rule, only by persistent fishing that satisfactory strings of fish of legal size can be taken. Notwithstanding this fact, young black bass up to a few inches in length seem to be fairly common. During August and October of 1910 and July and August of 1911 young from 2 up to 10 inches in length were observed in considerable numbers in places about the shores, especially at the steamboat pier at Blodgetts Landing.

In 1911 the largest fish observed by the writer was estimated to weigh 4 pounds and was one of a catch of 17 fish that perhaps would run from 2 to 3 pounds each.

It is also stated that while years ago the fly fishing for black bass was unexcelled anywhere, the fish no longer can be caught on a fly, due to its having resorted to the deep waters, where it subsists upon smelts and other fishes occurring there. This idea arises from the fact that smelts are occasionally found in the stomachs of black bass and that the fish is sometimes caught at the deep-water fishing places. Of course, it is obviously unnecessary for black bass to go into deep water for an occasional smelt. In August, 1910, several instances of black bass at The Hedgehog fishing "grounds" were noted. Some were seen at not a great depth below the surface and others were caught there on short lines, but at no time was one known to be taken at the bottom. It was quite evident, at least, that the supposed deep-water bass were not at the bottom, and their stomach contents consisting wholly of insects, when there were any contents, supported the evidence. However, the possibility of black bass occasionally resorting to the greater depths is not disputed.

While the capture of a few small black bass (about 10 inches in length) on The Reef in gill nets by the white-trout spawn takers gave rise to suspicion that this fish might include spawn eating in its category of harmful traits, the empty stomachs of these specimens were circumstantial evidence in its favor.

That black bass will and do eat other fishes is undoubted. They have been known to eat young perch, as has been pointed out in the quotations, and the writer's notes show that they also have eaten shiners, chubs, young catfish (horn pouts), sunfish, black bass, pickerel, and smelts. But at Sunapee Lake during August, 1910, and July, 1911, both adult and young were found to subsist mainly upon insects and aquatic larvæ of insects. Perch are stated to have

once abounded in the lake; chubs usually abound in such favorable waters when their enemies do not preponderate; and pickerel were formerly common. It may be inferred, therefore, that black bass have been a factor in producing their scarcity. In the case of the perch and the pickerel the bass may have worked two ways: One by devouring the fish themselves and the other by eating their food. It is probable that when chubs were abundant they contributed a great deal to the food supply of perch and pickerel. Being deprived of this food, they were driven to other scarcer food, or to food obtainable with greater difficulty, which would tend toward their diminution in numbers.

Then there is the indirect effect on other fishes to be considered, as well as the direct effect on some of them. Pickerel and perch, for instance, driven to other food, would eat more of other fishes that they did not previously attack so extensively, or else they would deprive other fishes of food perhaps already scarce. Thus it may be seen that the direct and indirect effects of introducing nonindigenous fishes may be far reaching, as has already been pointed out.

As already suggested, it is impossible to state definitely the effects of the introduction of the fish. But it has been shown that certain fishes have almost completely disappeared, or have become very scarce as the black bass increase in numbers and size. But there is another thing that almost inevitably occurs in such instances. The fact that a fish exterminates any other fish indicates that the particular exterminated form was the most sought or the only one available. This food being exhausted, it has to resort to other forms which are not so easily obtainable and to feeding upon its own young, with the consequences that the introduced fish decreases in size and diminishes in numbers. Judging from the foregoing reports of the former abundance and size of black bass and the present comparative scarcity and decreased size, it would appear that something like this has happened to the black bass of Sunapee Lake.

Pike Perch (*Stizostedion vitreum*).

The pike perch is variously known in different localities as wall-eyed pike, pike perch, dore, grass eye, yellow pike, blue pike, jack salmon, salmon, white-eye, pike, and pickerel. It is a member of the perch family along with the yellow perch. Its natural geographical range is the Great Lakes region, upper Mississippi, north to Assiniboia and Hudson Bay region, east to Vermont and Pennsylvania, and south to Georgia and Alabama. It is by far the largest species of the family and the most important commercially. It attains as high as 20 pounds weight.

It is a voracious, carnivorous fish, residing in the colder waters of the lake or river that it inhabits, for which reason its successful acclimatization in Sunapee Lake would have been deplorable, as it there would have inhabited the same waters with trout and salmon.

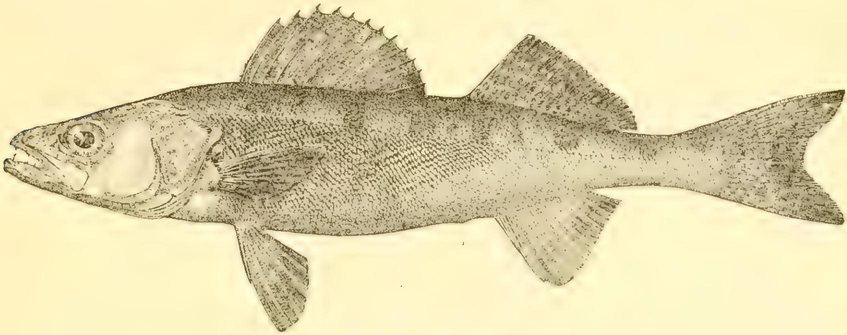

FIG. 4.—Pike perch.

The State Fish and Game Report for 1876 says:

> In May fish were procured from Alburg, Lake Champlain, and some of them planted in Sunapee Lake, probably the waters most suitable to successful fish propagation in our State.

Nothing further has been reported regarding this plant, and upon the whole it is undoubtedly fortunate that this is so.

PERCH (*Perca flavescens*).

The perch is a common fish in most New England fresh waters, and in many places it fairly swarms. It is carnivorous and almost omnivorous in that direction. It subsists mainly, however, upon small fishes and insects and is very destructive to young fishes and fish eggs.

The perch reaches a weight of at least 2 pounds in some waters, but as most commonly known averages not over one-half pound as a hook-and-line fish. It is a delectable pan fish, notwithstanding prejudices based upon fallacious or mistaken reasons entertained toward it. While its young afford food for other species of fish as well as itself, it in turn devours the young of others. The perch seems to have been indigenous to Sunapee Lake and at one time to have abounded there, as indicated in this paper by reference to it in connection with the black bass.

Wherever the perch abound the young are always conspicuously manifest about the shores and in shallow water, especially along beaches. But in the two seasons that the Bureau of Fisheries party made observations at Sunapee not a single young yellow perch was seen, and the only adult seen was one 12 inches long found dead at the surface on July 28, 1911, below the narrows. It showed no indication of having been hooked and there were no other lesions to which its

death could be ascribed. The blame for its scarcity in Sunapee Lake, as has been seen in the discussion of the black bass, is laid to the door of that fish, but there are instances of the complete extinction of perch in ponds where there were no black bass or other large fish to devour them. This is presumably due to some epidemic or cataclysm that destroyed them. A fact that would seem to weaken the contention that the black bass is responsible for the disappearance of perch is the fact that there are ponds where both species still exist in undiminished numbers. But that may be accounted for by assuming the presence of other food better suited to the taste of the black bass.

BATRACHIANS.

The following observations were made upon the frogs, toads, and salamanders of Sunapee Lake and vicinity:

Hyla versicolor (tree toads) were found in large numbers, breeding, April 15, 1910.

Hyla pickeringii (tree toads) were heard "calling" on April 22.

Rana catesbiana (bullfrog); one individual was seen in King Hill Brook April 22.

Rana clamatans (green frog) was seen August 12 in Blodgetts Brook.

Rana sp. (tadpoles) in large numbers were observed in a pool near the mouth of Blodgetts Brook, October 20.

Bufo americanus (common toad); many were heard calling on April 22, 1910, and one was caught in a fyke net at the head of Pike Brook dead water, August 16, 1911.

Diemyctelus viridescens (water newt). The red or so-called land form (*D. miniatus*) was found among the alders bordering Pike Brook, April 20, 1910. In shallow water at Soo-nipi Park beach one "heavy" with eggs was found, and in Pike Brook a male was taken on April 23; also one in King Hill Brook August 25. A number were caught in a fyke net set in Pike Brook outlet through the beach, August 17, 1911.

Spelerpes (?) sp. ("evets"). These salamanders were quite numerous in Blodgetts Brook. They are used for black-bass bait.

MOLLUSKS.

The mollusks collected at Sunapee Lake have been identified by Dr. W. H. Dall, curator of mollusks, United States National Museum.

Lampsilus complanatus ("clam") was caught on a troll hook, April 22, 1910; many specimens were gathered in shallow water along the sand beach on the south side of Blodgetts Cove. One of a "swollen" shape was found near the mouth of Blodgetts Brook left by the drying up of the brook, October 20. The species was common everywhere on sandy shoals.

Planorbis bicarinatus. Large numbers were found washed up in "windrows" on the beach at Soo-nipi Park, October 15. Dr. Dall pronounced them very large and fine specimens. This gastropod is evidently abundant in the lake, especially on sandy shoals among the *Chara*.

Campeloma decisa ("snails"). A few specimens were found with *Planorbis* on the beach.

Physa heterostropha ("snails"). A few were found with the preceding and many were collected in a pool near the mouth of Blodgetts Brook, October 20.

SUMMARY AND CONCLUSIONS.[a]

INDIGENOUS FISHES.

There seems to be very little that can be learned regarding the conditions of Sunapee Lake and its fish fauna prior to the beginning of fish culture. But such evidence as there is indicates that the original fauna, with perhaps the addition of the smelt, was the one to which the lake was best adapted.

Native trout.—Tradition indicates that this species once abounded and attained a large size, and the present conditions indicate that the lake was well adapted to the fish. The abundance of smelts has increased its food supply, but, notwithstanding this, it has decreased in size and numbers almost to extinction. The decrease in numbers is believed to be due to lack of early protection and inadequate propagation and to destruction by landlocked salmon. Of the conditions favorable to trout, about all that remains is the food supply.

White trout.—In view of all the known facts, it may be concluded that the white trout was indigenous to Sunapee Lake and the probabilities are that it was once small and inconspicuous from its size and habits.

The first knowledge of the white trout dates from its discovery spawning on the reef, when the fish ran very large. In the matter of time in which to grow, comparing the time of discovery and the date of the introduction of smelts into the lake with the discovery of the first blueback of large size and the date of the introduction of smelts into Rangeley Lakes, all is greatly in favor of the white trout. If the foregoing hypothesis is true, the present size of the white trout

[a] The request that the Bureau of Fisheries make a study of the biological and physical conditions of Sunapee Lake, in order that it might intelligently advise how to improve and maintain the fishing, originated with the Sunapee Lake Fishing Association, whose members are conscientiously desirous of improving and maintaining the fishing and are making every active and financial effort to accomplish those results. It is therefore hoped that the suggestions and recommendations herewith offered may assist to that end. The writer recognizes that his views are not infallible and may prove erroneous, but based as they are upon two seasons' observations at Sunapee Lake, all the literature obtainable regarding those waters, and many years of general experience, he can not help feeling that at least some of his opinions are well founded. He wishes to state that he alone is personally responsible for them, and no one else connected with the Bureau of Fisheries necessarily indorses them.

is due to abundance of food, and the food still abounds. So far, then, as breeding and feeding conditions alone are concerned, the lake is as favorable as ever for the existence of the white trout.

The other indigenous species are either too scarce or too unimportant to merit further discussion than has already been given them in the foregoing report.

INTRODUCED FISHES.

The dangers to indigenous forms by introducing alien predatory fishes into any lake have been discussed, and have to some extent, perhaps, been exemplified in Sunapee Lake, especially with the salmon. By the advent of the chinook, unless checked, these dangers bid fair to be still further demonstrated, modified more or less by the abundance of smelt food at present.

Of the introduced species only the smelt, black bass, landlocked salmon, and chinook have manifested themselves in sufficient numbers to produce any appreciable effect on the conditions and fauna of the lake.

Smelt.—The smelt has been the savior of the salmonids that still exist in the lake, for without the smelt the trout doubtless would have disappeared long ago or the white trout would have continued small and rapidly disappeared before the landlocked salmon and trout combined, as in the case of the blueback at the Rangeleys. The salmon would not have attained the large size that it did. The small salmon would not have yielded so many eggs, and the salmon stock would have more quickly become reduced in numbers.

The smelt evidently does not find sufficient food to cause it to reach the size attained in some lakes. (It is possible, however, that the Sunapee smelt is a different species from the large ones referred to.) But the small size renders it all the more suitable for fish food.

Landlocked salmon.—This fish, once fairly numerous, has greatly decreased in numbers, owing, no doubt, to its inability to find suitable natural breeding places and insufficient fish-cultural attention. So far as the two species of trout are concerned, this is an advantage, but it has been offset by the continued introduction of another salmon.

Chinook.—Sunapee Lake seems peculiarly favorable to some phases of the chinook's existence, principally that of growth. But regarding it enough has already been said to indicate, to the writer's mind at least, that it is uncertain and undesirable. It must be obvious to everyone that an indefinitely continuous supply of chinook eggs from the West can not be depended upon. Therefore, unless the present stock of the lake shows itself self-sustaining, it is a waste of time, money, and fish to continue planting it. For the time will undoubtedly come when the supply of eggs must fail, then if the fish has been

continued in the lake at even its present number, the disappearance of the fishes upon which it feeds will have been hastened. When the chinook stock has also gone the lake will be worse off than ever before and there will be some who will call for recommendations as to how to improve and maintain the fishing.[a]

Black bass.—The black bass seems not to reach as large a size as it did in former years or to be so abundant. It has been suggested that the small size is due to a scarcity of the formerly more abundant cyprinid food, and to its habits being such that it seldom, if ever, gets into the deeper waters where the smelt abides. The smelt is occasionally found in the stomach of a black bass, but in such instances probably the smelt was not taken at the bottom. The principal food of the black bass at Sunapee, as has been stated, consists of insects and their aquatic larvæ. It is believed, and so stated by some, that the almost complete disappearance of the perch and scarcity of the pickerel are due to the black bass. This is possibly true, and the small size of the pickerel still remaining may be due indirectly to the same fish. It is doubtless of little or no harm to the salmonids.

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[a] Since this report went to press the Bureau has received a letter from Mr. Ralph S. Davis regarding the status of the chinook in Sunapee Lake in 1913.

Mr. Davis estimates that during the fishing season from 4,000 to 5,000 chinooks, averaging about 3 pounds each, and aggregating at least 6 tons, have been caught. He also cites evidence that some chinooks are spawning naturally in the lake.

By applying the figures given by Mr. Davis to what has been stated in this report it is easily seen that they support the present writer's conclusions, and he would have it understood that the recommendations based upon those conclusions are offered solely because he believes that they indicate the best means of improving and maintaining the fishing in Sunapee Lake.

Mr. Davis's statements, therefore, do not necessitate either a revision or repetition of the arguments presented in this report. A brief summary, however, may be desirable here.

Chinooks have gradually increased in numbers each year and in some instances have reached a fairly large size. The increase has been directly proportional to the number planted in preceding years, and has been manifest only in increased catches by anglers. A few fish approaching maturity and a few in breeding condition have been taken. The scarcity of fish in breeding condition indicates a scarcity of fish to reach that condition, for the fact that some have been caught during the breeding period suggests that inasmuch as special efforts were made to find them, had they been plentiful more would have been taken.

There is no perceptible increase in number of breeding fish, and the average size of fish taken by anglers has decreased.

A few fish reaching breeding condition and reproducing naturally would hardly have an appreciable effect on the maintenance of the stock.

A few only taken and yielding eggs to be hatched artificially and raised to fingerling or older stages would not be sufficient to maintain the stock.

The greater the increase in numbers of fish, the larger the number that will be caught.

If the catches of past years have not left a sufficient number of breeders to replace, by reproduction, those caught, continued plants will probably not do so, without stringent limitations of the catches. But even now 5,000 fish permit of an average of only 1 fish every 4 days to each of 200 anglers in the fishing season of 100 days.

It is doubtful whether a supply from outside sources could be maintained indefinitely.

An increase in number and size of a voracious species signifies an increased amount of food devoured.

To a lake of the size of Sunapee there must be a limit to the number of fish and the food supply, direct and ultimate, that it can support.

The main subsistence of the chinook, as of other salmonids, appears to be the smelt, but it has been shown that the other salmonids may suffer both directly and indirectly from the presence of the chinook. If this is not a certainty, there is still the possibility, amounting almost, if not quite, to a probability.

It would seem, then, that if the foregoing conclusions are correct the longer the plants of chinooks are continued the more certain it is that the future of Sunapee Lake is one of inevitable disaster so far as the Salmonidæ are concerned.

SUGGESTIONS AND RECOMMENDATIONS.

The present conditions of the fish fauna of the lake appear to be a scarcity of everything but smelt, sunfish, black bass, white trout, and perhaps chinook salmon, the latter not very abundant and of only temporary importance. Of the indigenous fishes only the sunfish and white trout are at all common. The sunfish is of little importance and the white trout not abundant. If the smelt alone had been introduced into Sunapee Lake and the propagation of the trout and white trout maintained, the writer is firmly convinced that the lake to-day would abound with those two species. If it were possible to bring the lake back to its pristine condition, the writer would advise that it be done and that the stocking of the lake be begun anew and that no other nonindigenous species than the smelt be admitted to Sunapee waters. If any exception were made it would be in favor of the black bass. As such a reversion can not be accomplished, it only remains to meet the conditions as they are and attempt to solve the problem of stocking and of maintaining the stock in the best way possible in accordance with those conditions.

It has been previously suggested that the original fish fauna, with the addition of the smelt, was the one to which the lake was best adapted. Those conditions have been upset and the question arises, Can they be righted? In order to do that, certain fishes must be got rid of. Can this be done?

The black bass appears to be comparatively harmless so far as the salmonids are concerned, so it may be disregarded.

The landlocked salmon is rapidly vanishing and if allowed to do so will no doubt totally disappear in a few years at the most.

The chinook can not possibly stay if it can not breed naturally there, and if no more are planted the lake will soon be free from it.

Other introduced fish have not appeared at all or in such small numbers as to cause no apprehension and therefore may be disregarded.

The native trout is scarce in the lake, but by persistent and plenteous planting it may increase in numbers and size again as the landlocked salmon and chinook disappear.

The white trout will also increase in numbers and perhaps in size for the same reasons.

Provided they are properly protected, there will thus be saved two of the most attractive native food and game fishes of New England waters.

"*Native" and white trout.*—It is recommended, then, that landlocked salmon and the chinook be allowed to go and their departure hastened; that attention be given to the propagation and protection of the trout; that each year as large a number as possible be

planted in the best tributary brooks or kept in retaining ponds until large enough to look out for themselves to some extent in the lake. Regarding the selection of brooks, it may be said that the temperature of King Hill Brook usually was from 1° to 2° higher than Pike Brook in the running water and pools in the woods. The spring pools were about the same as in Pike Brook, but the dead water, being more open, was considerably higher than the dead water of Pike Brook.

About the middle of August the woodland portion of Big Brook at Blodgetts gave the same temperature as Pike Brook, i. e., 58°, and Little Brook 2° lower.

The temperature at Sunapee Brook did not vary much from Big Brook at Blodgetts.

From the foregoing data it would seem that Pike Brook is the best brook and, in order, Blodgetts, Sunapee, and King Hill Brooks next. It is suggested that only Pike and Blodgetts Brooks be used, however, and possibly only Pike Brook.

In a few years, doubtless, the lake would furnish its own breeding trout and the expense of buying eggs and young trout would be obviated. The white trout still furnishes its own eggs in sufficient numbers satisfactorily to stock the lake in the absence of the predatory fishes previously mentioned. It has been suggested that the artificial propagation of this species be discontinued and the fish be given a chance to show what it can do unaided. The writer believes it would be unwise to do this, owing to the well-known fact that far more can be hatched artificially than under natural conditions. It is recommended, however, that, if possible, some other method than the one in use to collect breeders be devised and employed.

The brooks used as fish nurseries should be constantly closed and guarded for a number of years at least.

A close season for taking trout of either kind in the lake is recommended, from September 1 to May 1 (or until the ice has broken up in the lake, if preferred). No ice fishing should be permitted. It should be permitted to retain no trout of either species taken in the lake under 12 inches in length. Only single hook should be permitted, whether bait hook, fly, or other artificial lure. This is not intended to exclude two or three "single" hooks on a smelt line or two or three flies on a cast, but to exclude the use of gangs and grapples. An angler ought to be satisfied to fish for trout with one rod and with one hand line for smelts for bait. The practice of setting lines or rods over night from wharves, piers, and the shore or leaving them unattended at any time should be discontinued. The quantity of trout of either or both kinds legally to be taken by one man in one day should not exceed 10 pounds.

Salmon.—The foregoing applies to efforts to revive the native trout fishing and to improve the fishing for white trout, which the writer firmly believes can be done only, as said before, by ridding the lake, or allowing it to rid itself, of the undesirables previously mentioned. If, however, it is insisted that there must be salmon, let it be the landlocked salmon. It is undoubtedly as undesirable as the chinook in its fish-eating propensities and capabilities, and with an extensive cultivation of it in the lake the writer must repeat that he firmly believes both species of trout would eventually become extinct. But the landlocked salmon is superior in many ways to the chinook. It probably will reach as large a size as the chinook in Sunapee Lake; it is a much gamer fish; it bites as readily and it takes the artificial fly, which the chinook does not; it does not necessarily die after spawning, which the chinook always does; it is just as good eating; and a supply of eggs or young is much more easily and cheaply obtained.

Besides all this, Pike Brook and perhaps some others could be made accessible in breeding time and the stock be made again self-sustaining. The brook could be made accessible by digging or dredging through the beach and walling the channel jetty-fashion with logs. When the brook is not too dry this would cause a current that would keep the channel clear of sand. There is, however, usually plenty of water in the fall to permit the ingress of salmon if there were a channel of this kind through the beach.

In the place of gill nets, it is suggested that pounds or traps be set near the mouths of the brooks for the purpose of taking the salmon, as well as the trout, in the breeding season.

Salmon fry or fingerlings could be planted in the brooks. If retained in hatchery pools until a year or more old they could with more safety be placed in the lake. The planting of fry in the brooks in spring is recommended, if it is desired to economize in expenses. It is believed that fry planted in the brooks in the spring would produce better results than larger fish in the fall planted in brooks or lake, owing to the greater abundance of natural food at that time and during the summer. The only objection appears to be the possibility of the brooks drying up to such an extent during the summer as to leave the fish stranded. It is not likely that there will be severer droughts than during 1910 and 1911, and it has been shown that during those two summers there was sufficient water in Pike Brook and Little Brook at Blodgetts. Besides, young salmon will endure higher temperature than trout, and the pools of the meadows are always comparatively deep and not too warm for salmon. It is advised that a close time for landlocked salmon be for the same period as the trout. It is suggested that a salmon 12 inches long is a rather small fish of its kind, and the writer would advise making

the minimum limit 15 or 16 inches at the lowest, and the quantity legally to be caught in one day not to exceed 20 pounds (or one fish), including other species. The apparatus of capture should be restricted as in the case of the trouts.

Chinook.—If the planting of chinooks is continued, it is recommended that they be planted in the brooks mentioned, that breeders be secured if possible by the method suggested for landlocked salmon and trout, and that the fishing regulations be the same as for landlocked salmon.

Smelt.—As has been said, the smelt has saved the day so far as it has been saved. The smelt is very abundant in the lake at present. It is a prolific fish, which it has to be to offset the many adverse conditions that it has to contend with. Let alone, its habit of spawning in brooks insures a permanent and continuous stock of smelts, for in the brooks the eggs are comparatively free from enemies. Trout and young suckers feed upon the eggs to some but an inappreciable extent. The practice of dipping smelts as now carried on is not only very destructive to smelts but to their eggs. Besides the smelts caught, many are trampled upon and killed by the fishermen wading in the brooks. The eggs are also trampled upon and loosened and carried away by the current. Those eggs that escape one night are likely to be destroyed the next, together with newly deposited ones. It is well known that brooks that have been excessively fished have in time been abandoned by smelts, and in the case of some ponds the stock of smelts thus seriously depleted. The writer recognizes the prevalent desire to dip smelts and sympathizes with it, for the smelt is one of the most delectable pan fishes, and in Sunapee Lake can be taken at no other time or in no other manner in sufficient numbers to afford even a small mess.

It is recommended that the dipping of smelts be not prohibited, but the open time shortened or allowed for one or two nights in each week during the spawning run, and the catch by each person limited. Also, that the place of fishing be restricted to the lower part of each brook: In Blodgetts Brook to below the junction of the two branches; in Pike Brook to below the lower bridge; and the other brooks to be correspondingly restricted. All dipping should be done from the bank, with no wading in the brook.

Suckers.—It is recommended that the spearing of suckers be permitted during their spawning run, but from the banks of the brooks and not by wading in the streams, as the migration of the sucker for spawning takes place before the smelt eggs are hatched. No limit need be put on the catch or restrictions on the places of catching suckers.

Black bass.—The open season for black bass, if it is desired to protect them during the spawning season, should not begin before July

1, but may continue throughout the season. Its legal length should be not under 10 inches, and the other fishing regulations regarding methods of capture, as in the case of the trouts, should apply to it.

Species for introduction.—It is also recommended to stock the lake, if possible, with one or more species of cyprinids, preferably the redfin (*Notropis cornutus*), golden shiner, "roach" (*Abramis crysoleucas*), and gray chub minnow (*Couesius plumbeus*), which abound in many New Hampshire waters and perhaps in the smaller ponds not very remote from Sunapee Lake. The writer would exclude the two chubs, if possible, at least would make no effort to get them, if one or all of the others are available.

These minnows could be planted in the dead water of the brooks and they would soon become abundant if a large enough initial stock is planted. The gray chub minnow is primarily a lake fish, swimming in schools, and ascending streams to spawn much as the smelt, but somewhat later in the season. It would afford food for the black bass and pickerel as well as other fishes.

NOTE.—On page 46 it is stated that there seem to be no records of brown trout planted as such in Sunapee Lake, but in an article entitled "Pacific Salmon in Eastern Waters" (Forest and Stream, Mar. 2, 1912), Dr. John D. Quackenbos writes that in 1897 he planted that species in an entering stream, and he ascribes to that plant the 14-pound trout referred to on pages 46 and 47 and shown on plate VII of the present report.

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THE PROTECTION OF FRESH-WATER MUSSELS

By R. E. Coker, Ph. D.

Director U. S. Biological Station, Fairport, Iowa

Bureau of Fisheries Document No. 793

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THE PROTECTION OF FRESH-WATER MUSSELS.

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PRESENT CONDITIONS.

THE MUSSEL INDUSTRY.

The history of the fresh-water mussel industry gives illustration of the promptness with which an American industry may be developed once the pathway is found. Undertaken in a small way scarcely more than a score of years ago, the manufacture of pearl buttons began almost immediately to assume the proportions of an important national industry. As early as 1898, when the enterprise was only 6 years old, there were about 50 factories in more than a dozen towns along the Mississippi. With improved machinery and methods further expansion occurred, until within a few years the output approximated 30 million gross of buttons, with a value of many millions of dollars. The growth of the industry has continued to the present time, but exact figures will not be available until the Bureau has completed a statistical survey now in progress.

Not less important has been a resultant economic change, or modification of custom, that has affected practically every person in the country. Where marine pearl was in rare use, fresh-water pearl, with its quality and price, came to fill a universal requirement. In one decade pearl buttons were high in price, used only upon the better clothing, and commonly saved when clothing was discarded, while in the most general use were buttons of metal or agate or wood, which rusted or broke or warped. In the next decade good pearl buttons, neat and durable, were available to everybody and used upon the widest variety of clothing. A former luxury had become a common necessity.

Coincident with the rise of the manufacturing industry, there developed an important and widespread fishery, directly employing thousands of persons and indirectly affecting persons and communities of varied occupation. Commencing on the Mississippi

River, the fishery gradually spread from stream to stream, passing from depleted territory to new and rich fields, until it embraced practically the entire Mississippi Basin and a portion of the Great Lakes drainage, from Minnesota to Louisiana, north and south, and from Ohio, West Virginia, and Tennessee on the east to Arkansas, Kansas, and South Dakota on the west.

DEPLETION OF THE RESOURCES.

Extension of territory could not be continued indefinitely. While up to the present time the industry has not failed to obtain shells in quantity sufficient for the market demands, it has become perfectly clear that the perpetuation of the industry as one producing a staple product that is both good and within reach of all people depends upon successful propagation and effective protection. The supply is now maintained by regularly invading new territory (and it is scarcely possible to go farther in this direction), by seeking out the smaller tributaries of the mussel streams, which could not formerly have been worked with profit, and in some measure by the devising of methods that are more effective in capture of mussels. Notwithstanding these developments, all of which indeed conduce to more exhaustive fishery, an increasing proportion of very small shells is being taken, the bottoms are being more thoroughly cleaned, and the price of shell has advanced to a relatively high figure.

A high price for shell has, of course, its advantages. It is good for the fishermen, provided they can find the shells, and it stimulates the manufacturers to eliminate waste and to use the most economical methods. On the other hand, if unbalanced by protective restrictions, a continued rise in price is of disastrous consequence. It impoverishes the beds by driving the fishermen to the most exhaustive manner of fishing; even the very smallest shells that can be captured, which should never be removed from the beds, are taken and marketed, and this, unfortunately, is the actual case at the present time. (See pl. I.) Ultimately the higher price of shell becomes an element in the price of the finished product and is paid by the public at large without corresponding advantage to a single person connected with the industry.

Let it be repeated that a high price to the fishermen is desirable, but in the present condition they reap no benefit. A higher price for a disproportionately smaller product brings no added profit. None are so directly interested in the conservation of mussels as the fishermen themselves.

Of what advantage is it to the fishermen of the Wabash River, or to the State of Indiana, that shells are now more valuable, when a river that once supported a really important shelling industry is

now practically depleted? Wherein is the benefit to Illinois, when only one fisherman can engage in shelling to-day where six worked with profit five years ago? What profit will Arkansas find, when its rivers are now the scene of the most exhaustive mussel fishery ever known and the future is being robbed by the removal of infant shells that are shipped to the markets to be subsequently thrown into the discard by the manufacturers as too small for any useful purpose?

THE INTERESTS OF THE COMMUNITY.

An earlier general interest in the subject would have been awakened had there been a better knowledge of the importance of shelling industries to the communities at large. As an illustration, the case of Madison, Ark., may be mentioned. The town itself has a population of about 300 and is supported by lumbering, farming, and fishing industries. During each of the past two years shells and pearls have been marketed at this place to the value of about $20,000. This was a crop that could be counted upon regardless of weather conditions during the season, and it constituted a substantial element in the income of the community at large. Can this income be counted upon in the future? A dozen years ago fishermen made their wages when shells brought $4 per ton, and they can do no better at this time, when they receive $23 per ton. In 1913 they took 200 to 300 pounds per day, where originally they made daily hauls of 1,000 to 1,800 pounds. The shells are now, it appears, about one-sixth as abundant as they were a dozen years ago. This is a rapid rate of depletion, and it is evident that the future can have little to offer unless something is done to insure the self-perpetuation of the mussel beds.

The town of Black Rock, Ark., which has a population of about 1,000, offers an illustration where both fishing and manufacture are involved. It is estimated that approximately $50,000 is brought into the town and the territory about it each year, of which by far the greater amount is paid out in the town of Black Rock itself. What does the future hold for this place? Reliable information shows that while a few years ago a sheller could take 1,200 pounds or more per day from the Black River at Black Rock, the daily catches now run from 100 to 200 pounds. Although shells are bringing about $20 per ton, there is scarcely a daily wage to be made, and as a consequence the shell fishery immediately about Black Rock is almost negligible. The shelling is now prosecuted principally above Black Rock, in the upper waters and tributaries of the Black River, as about Pocahontas and elsewhere. The process of depletion is unchecked and the condition is clearly such as to awaken the enlightened sentiment of the community and the State at large

to support measures that will insure permanent life and prosperity to the industry. Here is a business that yields a relatively fixed return in comparison with agricultural industries, which are so generally affected, favorably or unfavorably, by the vicissitudes of weather conditions.

It is of much more immediate concern to the community at large than it is to the purchasers of shells or to the shellers themselves that the resources of a particular region should be conserved. It is a comparatively simple matter for the manufacturer to strip his plant and to remove his machinery to another locality with undepleted resources; it is an easy thing for the sheller, with his scant equipment in a house boat, to float down the river, looking to find another temporary home where his labors may be more profitable. It is the interest of the community that is threatened. The loss of a substantial industry affects the profits and the welfare of innumerable persons who may have known little of their indirect interest in a business in which they did not immediately participate. The communities most immediately affected are those of the river towns which, as a general rule, are too limited in their sources of fixed income.

From the standpoint of community economy, an unfortunate feature of the mussel fishery, as it has been pursued up to this time, has been its nomadic character. The policy everywhere has been to clean up the beds of a locality, or of a stream as a whole, and then to move to new regions. Temporary cutting plants, or "factories," have frequently been established in the vicinity of active shelling, to move subsequently as the local fishery passed away. Only the larger and more firmly established branch plants of the principal factories have maintained a fixed location.

It will be brought out later in this report that it does not appear possible to insure the best condition of the mussel beds, except by some plan of rotation; but it would be desirable and favorable to the interest of all for the mussel fishery to be a permanent and dependable feature of the industrial life of the broader communities, if not of particular restricted localities.

The perpetuation of the mussel resources may well receive the best consideration of every State concerned and of the National Government as well. It affects the welfare of thousands of shellers, of hundreds of river towns over the broad Mississippi-Missouri Basin, of manufacturers and laborers, east and west, and, it might be said, of every user of pearl buttons, which comprises practically the entire population of the country.

The Government and the States can accomplish the desired object by two principal means—artificial propagation and legislative protection. It is the province of the present paper to deal primarily

with the subject of protective measures, but it will be advisable to give first an abbreviated account of the conditions and possibilities of artificial propagation, especially as the results of propagation will be greater or less according to the degree of protection extended to the young mussels.

ARTIFICIAL PROPAGATION OF MUSSELS BY THE GOVERNMENT.

ESTABLISHMENT OF PROPAGATION.

The Bureau of Fisheries has always maintained an active interest in the development of the fresh-water mussel fishery of America, which, in its importance and breadth of territory, is entirely unique in the world. As early as 1897 and 1898, the shell fishery being then only 4 or 5 years old, the Fish Commission undertook investigations relating to the various phases of the industry, and several reports were published dealing with the natural history of mussels, the shell and pearl fisheries, and the button industry. In a general report on the subject Dr. Hugh M. Smith then recommended measures for the protection of mussels. No action followed, and in consequence the scene of the most important fisheries has greatly shifted since that time.

Some years later there began a special investigation of the reproduction of mussels, which resulted in the methods of artificial propagation as developed by Prof. Lefevre and Prof. Curtis, of the University of Missouri, in association with the Bureau. The Government then established the Fairport Biological Station to engage in the propagation of mussels and the studies of mussel problems, besides exercising wider activities in fishery investigations. For a number of years field investigations relating to the distribution, habits, and conditions of life of the mussels have been prosecuted by the staff and associates of the Bureau throughout the Mississippi Basin.

For the first two years at the Fairport station mussel propagation was carried on in an experimental way, but beginning with 1912 the practical operations have been conducted upon as large a scale and over as wide a territory as the available resources permitted. During the past two years mussels have been propagated chiefly in the Mississippi River from Lake Pepin, in Minnesota, to New Boston, Ill.; in the Wabash River in Indiana, and in the White and Black Rivers of Arkansas. During the year ended June 30, 1913, about 150,000,000 glochidia, or young mussels, were put out, and in the first half of the present fiscal year that number is fully equaled. Such figures appear large. It is not difficult by the methods of propagation to handle considerable numbers of glochidia; indeed, it is necessary to work on an ample scale, for in mussel propagation, as in most forms of fish culture, what we can now do is to aid the young over the most

critical period in their life history, after which they must be left to continue the struggle for existence by their own efforts.

We therefore plan to work in such a way that, even with the liberal discount that nature will surely apply to our returns, there may be left a real measure of benefit gained without undue cost. Many of the young will be lost from falling upon unsuitable bottoms and from many other unfavorable conditions, such as confront every young mussel in nature with more or less frequency. We would like to remove all of the unfortunate conditions productive of loss, both to the mussels that we put out and to those that are propagated entirely by natural means; but this, of course, is not possible. There are, however, artificial conditions which do injury to the younger mussels, and it is both desirable and practicable to prevent such damage as far as can be done reasonably.

RESULTS DEPENDENT UPON PROTECTION.

In the regular fishery for mussels the beds are continually dragged over with rakes, tongs, crowfoot hooks, or dredges. It is inevitable that the young mussels will suffer to some extent from this process. It is quite unnecessary, however, for the "infant" mussels, many of them too small for any use at all and many more too small for any economical or proper use in manufacture, to be entirely removed from the beds. Mussels are thus uselessly destroyed that might be left to grow to a size at which they would be both commercially valuable and properly usable; meantime, too, they might take their natural part in the reproduction of the species.

Furthermore, it would be desirable to leave portions of the rivers entirely undisturbed by the operations of shelling during periods of some years. This would accomplish a double object—it would leave the best conditions for the natural reproduction of the remnant of the old stock and for the growth of the young mussels and at the same time it would create a series of reserves in which artificial propagation could be carried on with the best conditions for maximum results. In such closed regions the young mussels would have to contend against only the normal unfavorable conditions which all mussels have ever had to withstand, without an added toll of destruction being taken by the direct and indirect effect of the operations of men.

The simple "closing" of a depleted region, if the exhaustion has not proceeded too far, may be expected to lead to sure betterment, and even in time, if the closure were for a very long period, to a restoration of the former condition when mussels were so richly abundant. It will be advisable, however, to supplement natural processes by the methods of artificial propagation in order that the

replenishment may be hastened and a greater result gained in a shorter time. We have to contemplate that the beds that may be closed will have to be reopened after a definite period, for the fishermen can not afford to work indefinitely on restricted and depleted areas, and the supply of available shells must be maintained. A proper solution as fair as possible to all will be found in a plan of rotation which will give rest periods to the different portions of a river in succession. Let this measure be supplemented as far as may be by Government or State propagation of mussels in the resting regions.

It is apparent that artificial propagation and protection are intimately related. Restrictive measures alone will yield benefits, but these will be greater if the protection is followed up by well-directed propagation. Artificial propagation pursued independently may be expected to bring results, but the advantages will be considerably diminished if no steps are taken to lessen the unnecessary destruction of the young mussels thus given a start upon life.

PROTECTION.

ESSENTIAL CONSIDERATIONS FOR EFFECTIVE LEGISLATION.

Although at least 20 States participate directly in the mussel fishery for the shell trade, only 2 or 3 of these have taken any action of any kind for the protection of the resources. In some others measures have been proposed at various times, but without receiving favorable consideration by the legislative bodies. Indeed, it is probably well that this is the case, in view of the fact that there has been no general presentation of the case from all sides to aid in a just consideration of the matter. The Bureau is prompted to make this report in the hope that suggestions based upon a long-continued investigation of the shelling industry in all its phases may be of material aid to the responsible bodies concerned in the determination of how best to perpetuate the mussel resources, giving due regard to the local conditions involved.

Any legislation to be most effective must fulfill certain general conditions. It must be based upon just consideration of the welfare of all classes legitimately interested in the business, including shellers, buyers, manufacturers, and the public generally. This is important not only because fairness demands it but because it is manifestly impracticable to enforce a law which is framed in disregard of economic requirements. A law that makes possible the creation of a monopoly, or one that drives the buyers and manufacturers from the territory, or that sacrifices the good of the industry to revenue production to the State, would be so manifestly unsound that further comment seems unnecessary.

Nevertheless, the element of sacrifice can not be entirely eliminated. In this case, as in others, ultimate benefits can scarcely be obtained without some temporary sacrifice, although it should be aimed to make the immediate loss felt as little as possible. It is the unwillingness of individuals to make voluntary sacrifices, independently, for the good of the mussel beds that makes legislation of any kind necessary. There is a demand for legislative action only because, in the end, the welfare of all parties concerned is dependent upon the promotion of abundant growth of mussels.

Finally an eminently desirable feature of any legislation is that it shall be so simple, plain, and undebatable as to minimize the difficulty of enforcement. Coupled with this there must be not only an effective penalty but machinery of enforcement that will work simply and certainly.

The measures to be proposed will be considered in the light of these requirements, together with the basic conditions offered by the natural history and the conditions of life and reproduction of the mussels.

EXAMINATION OF PROTECTIVE MEASURES.

TWO MEASURES FOR IMMEDIATE APPLICATION.

As appears from the remarks hitherto made, the restrictions which are immediately required for the preservation of the shell resources are—

(1) The imposition of size limits for the protection of young mussels.

(2) The adoption of a plan of rotation of closed regions, whereby the mussel beds may be given the best opportunity for propagation and growth.

We do not at this time advocate any other limitations, and it will be attempted to show that these are so simple to apply and so promising of effectual conservation that it is strongly advisable not to complicate the situation by a needless multiplicity of restrictions. These two measures will be fully discussed in subsequent sections of the paper.

MEASURES NOT SUITED TO EXISTING CONDITIONS.

Two other measures that have been more or less frequently proposed are the provision of a closed season during certain months and the restriction of the methods of taking mussels. While it is the purpose of the present paper to discuss more especially the positive suggestions that are offered, it is not out of place to give briefly some of the reasons for exclusion of measures which may have been suggested by friends of the industry with sincerity of purpose and which are not upon their face devoid of merit. Always let it have the first place in our minds that the one object in view is not to hamper but to develop the mussel fishery.

Closed season of months.—The aim in establishing a closed season for the mussel fishery during a portion of the year is either to protect the mussels from disturbance during a breeding season or else to diminish the extent of the fishery by limiting its duration.

It might be very proper to protect the mussels during the active breeding season, if such a season could be defined; but, as a matter of fact, the various species of mussels in any particular stream have different seasons of breeding. The mussel industry is based upon a considerable number of species of economic mussels. There is a group which has a short breeding term during the summer months. Such are the species known commercially as "niggerhead," "pimple-back," "monkey-face," "maple-leaf," "blue-point," "three-ridge," etc. The "washboard" seems to have an intermediate breeding term during the early fall, though it may be that in some cases it carries its spawn into the winter. Many of the more important species of mussels have a long term of breeding; in the latter part of the summer and in the early fall the eggs are deposited into brood pouches within the shell of the female, and there, after they hatch and develop, they are carried over the winter, to be liberated in the spring and early summer.[a] Of this kind are the "mucket," "sand-shell," "pocketbook," "butterfly," and others.

In view of the variety of commercial mussel species and the diversity of breeding seasons, it does not appear practicable to determine upon a closed season that will accomplish its particular purpose. The Illinois law prohibits the taking of mussels in any navigable water in that State between the 1st day of October and the 1st day of April; but, as illustrating how such a measure may apply in a particular case, practically all of the mussels in the principal river of that State—the Illinois River—are short term or summer breeders, spawning some in June, July, and August, others in October and about that time. Only a few carry the spawn, after its development, through the winter.

The principal objection to an enforced interruption of the fishery during a period of months is that it deprives the mussel fishermen of the right to earn a living by their profession during a portion of each year. This objection has real weight, and should be overborne only by decided advantages to be gained from a closed season.

Restricting the methods of fishery.—The principal implements for taking mussels are the crowfoot bar, the rake, the fork, the tongs or scissors fork, the dip net, and the dredge. These several pieces of apparatus are variously adapted to conditions of depth, rate of current, and character of bottom, as well as to the aptitudes and customs of the fishermen. Before a method should be prohibited it should be

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[a] Possibly these mussels liberate glochidia to a limited extent during the fall and winter; but the general statement is well founded.

known that it can be replaced by one of the more suitable methods, or else that it is so positively injurious as to require its elimination. The only implement of capture against which complaints are generally made is the crowfoot hook, but this is the only method in general use which is adapted for taking mussels in the deeper water, and it is probably in more common use than any other method. Perhaps in time improvements upon this hook will be adopted to lessen its injuriousness, or other methods capable of replacing it will be better known. In the light of present conditions it would work an unnecessary hardship upon a very large number of fishermen to prevent its use, especially when it appears that the protection of the mussels can be accomplished by methods more equitable to all concerned.

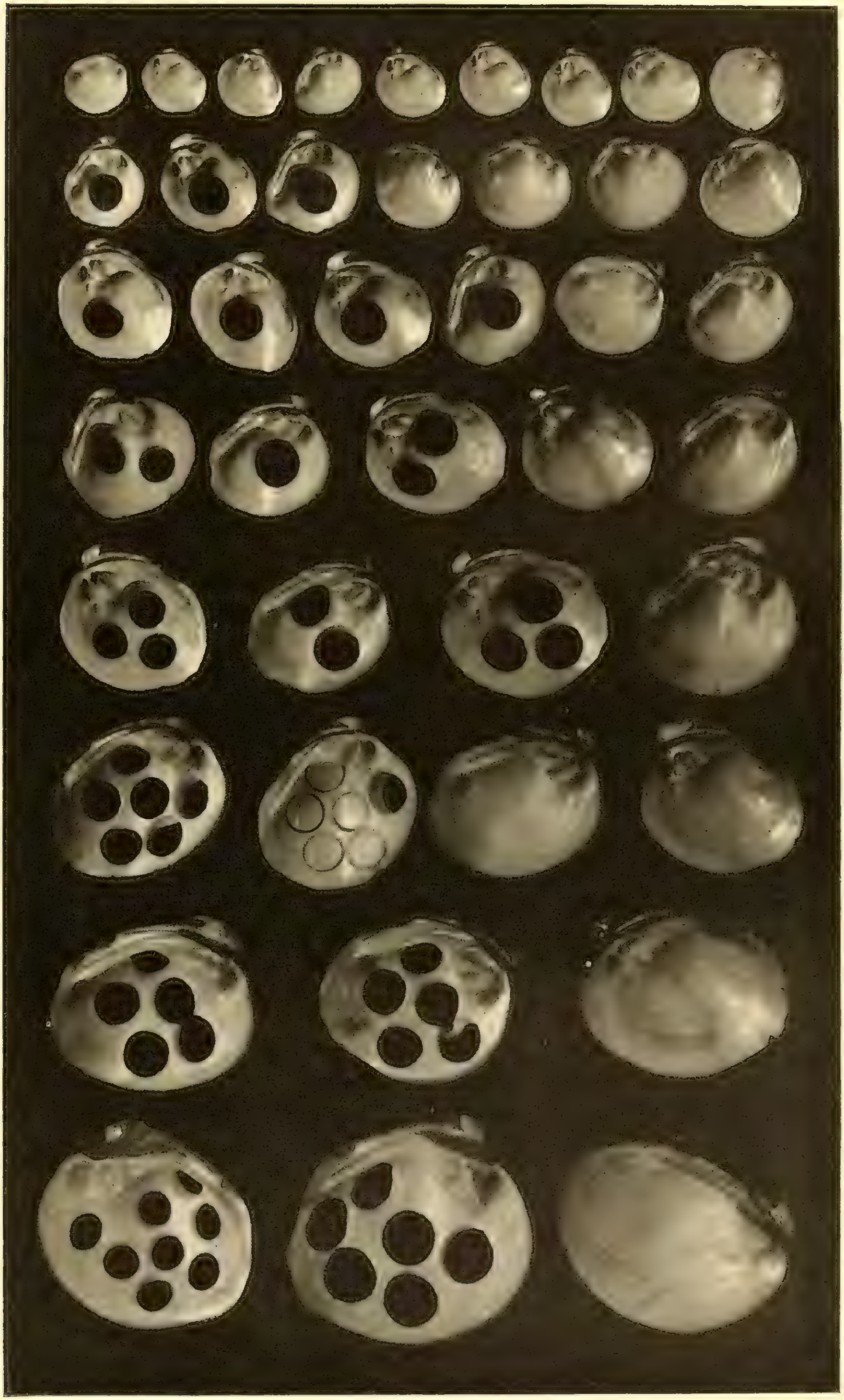
Still other measures have sometimes been advanced looking to the limitation of the number of shellers to be permitted to work within a given territory or to the leasing of shelling rights. Since such proposals have not yet been offered in connection with any properly worked-out plan by which serious injustice would be avoided and the interest of the public safeguarded they may be dismissed with the remark that it is not simply the protection of mussels that is desired but the protection of the mussels for human use without interference with common human rights. The absence of inherent wrong in an idea does not commend it if it carries within itself the seeds of its own defeat by a method of application, or a want of method, that allows opportunity for manifestly unjust and intolerable conditions to arise.

There remains to deal with the necessity for the two measures that are advocated and to discuss the methods of application. This can be more adequately done in distinct sections.

SIZE LIMIT—NECESSITY AND APPLICATION.

EXHAUSTIVE NATURE OF THE FISHERY.

The necessity for imposing restrictions upon the size of mussels to be removed from the beds is brought out more clearly by the photographs than could be done by any lengthy discussion. All of the shells shown in plates I and II were actually taken for market, sold, and shipped to the factory. The smallest ones (in the three upper rows on plate I) were not wanted at any factory; they were bought only because the fishermen had thrown them into the piles along with the larger shells, "to add weight." Most of the very smallest shells, those under 1 inch in length, are subsequently lost in handling, by falling through the forks or otherwise wasting as they are thrown into the car or from the car to the bin. None of the shells in the three upper rows of plate I would ordinarily be used by any manufacturer. It is true that some of the shells shown



SMALL SHELLS ACTUALLY MARKETED. ALL EXCEPT THOSE OF THE THREE LOWER ROWS SHOULD BE LEFT IN THE RIVERS.

[About one-half actual size, which is shown in inches at right of plate.]

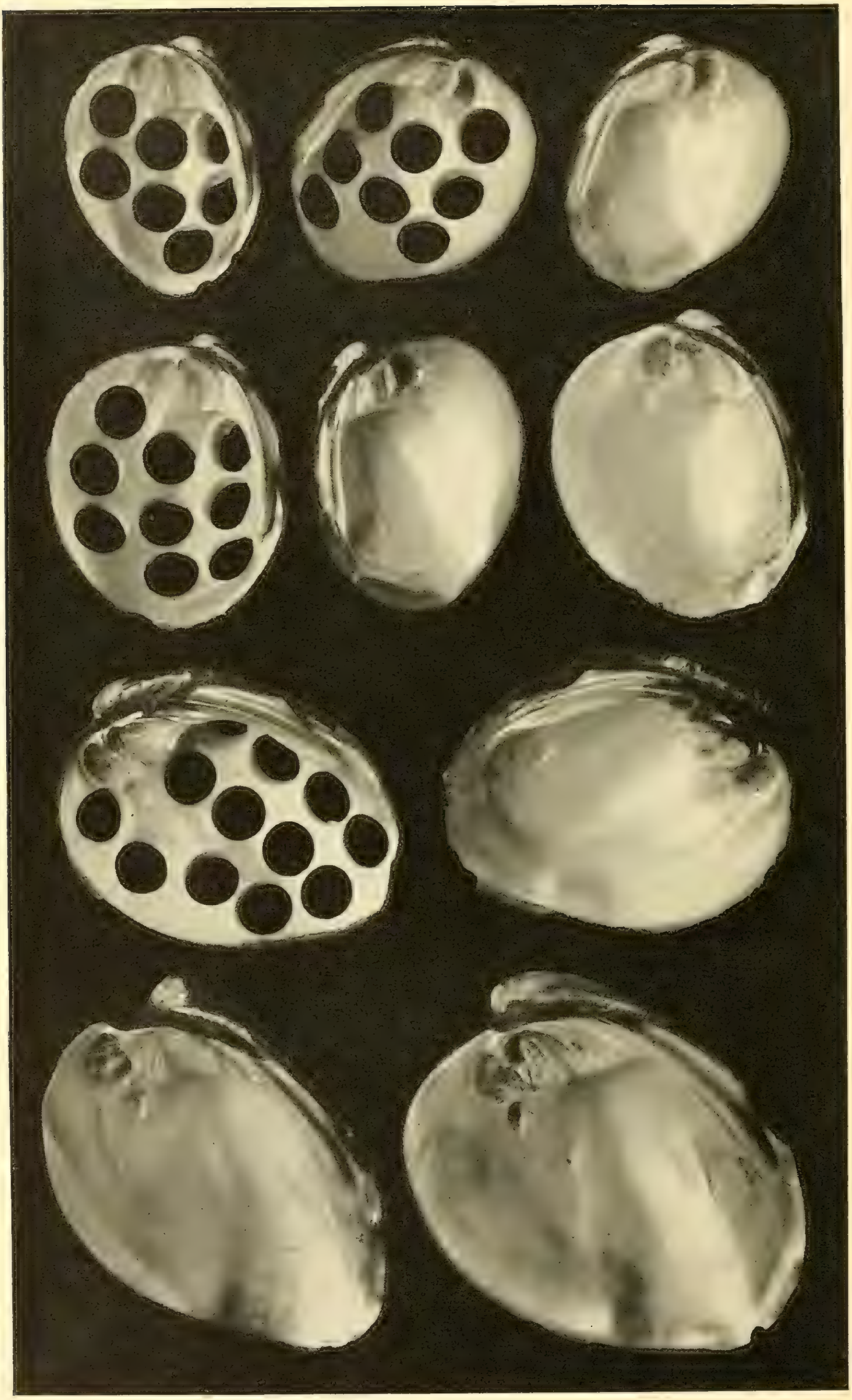
Ins.

2¾

3

3½

4



LARGER SHELLS MARKETED AND ADVANTAGEOUSLY USED.

[About one-half actual size, which is shown in inches at left of plate.]

have had one blank cut out, and these were actually cut at a commercial plant, but the instance was a very rare one and was certainly unprofitable. Even if the manufacturer desired it, the cutters will not handle shells from which only one blank can be cut, since the waste of time outweighs the saving of material.

Consequently all shells less than about 1½ inches in length, no matter what the quality, are thrown into the discard. *There can be no difference of opinion as to the pure wastefulness of taking shells of this size.*

The shells shown in the illustration are not the smallest that could be found. Some shells observed in the fishermen's boats were only one-half inch in the greatest diameter. Out of the water these are entirely without use. The fisherman who saves them, thinking that they add weight to his heap, would doubtless be surprised to learn that he would have to handle several times and clean 200 of such shells to add 1 cent to his earnings, for it would take nearly half a million of them to make 1 ton.

The shells in the fourth and fifth rows, counting from the top in plate II, are used at the factories when received, and are sometimes particularly favored where the quality is as good as in those from many Arkansas rivers, and the shells will yield two or three blanks of 16 to 20 lines. Such blanks are of a suitable thickness and work up economically besides having a good quality. Some of the shells in these two rows show how blanks of 18, 16, and 14 lines are worked out, a "line" in button measure representing the fortieth part of an inch.

The use of shells taken between 1½ and 2 inches in greatest diameter does not, therefore, like the marketing of those under 1½ inches, represent absolute waste, but it does denote relative waste or real shortsightedness from the economic point of view. Shells of this size will average about 30,000 pairs to the ton, while mussels of such a practical size as 2½ inches will average only 15,000. The number of blanks obtained from a ton of shells of the latter size would be just the same as from a ton of the smaller shells, notwithstanding that only half as many shells are handled. *We are thus, when using the smaller shells, depleting the mussel beds at twice the necessary rate without any corresponding advantage.*

WASTE ILLUSTRATED.

There is given below a table that will repay careful examination as illustrating the wastefulness of using the small shells. While the figures must be understood to be only approximate, they are based upon careful weights and counts of a number of shells from several localities. The shells were all "niggerheads" and were all obtained after shipment to factories.

The first two columns show the limits of size for each lot used, the greatest diameter being the basis of measurement.

The third column shows the approximate number of pairs of shells composing a ton, the unit of purchase; multiplying this number by 2 would give the number of single shells per ton.

In the fourth column there is given, in the case of the critical sizes, the number of 18-line blanks readily taken from a single shell (which is one-half the number yielded by a pair of shells, or an individual mussel).

The fifth column indicates the number of gross of blanks, by computation, yielded by a ton of shells. This computation is based upon the cutting of 18-line blanks (not the larger 20-line blanks that have been taken from some of the larger shells in the illustration). Some of these shells are cut excessively close to the tips, on account of taking too many larger line blanks. It must be understood that different sized shells are adapted for different lines of buttons. The data herein is for comparative purposes only.

TABLE OF SIZES, WEIGHTS, AND BUTTON PRODUCTION FOR NIGGERHEAD SHELLS (APPROXIMATE FIGURES).

Longest dimension.		Number of mussels per ton.	18-line blanks per single shell.	Quantity of blanks per ton.	Refer to illustration.
Greater than—	Less than—				
Inches.	*Inches.*			*Gross.*	Plate I—
$\frac{3}{4}$	1	174,000	....	....	1st row.
1	$1\frac{1}{4}$	110,000	....	....	2nd row.
$1\frac{1}{4}$	$1\frac{1}{2}$	55,000	....	....	3rd row.
$1\frac{1}{2}$	$1\frac{3}{4}$	33,000	2	917	4th row.
$1\frac{3}{4}$	2	26,000	3	1,008	5th row.
2	$2\frac{1}{4}$	20,000	4	1,111	6th row.
$2\frac{1}{4}$	$2\frac{1}{2}$	15,000	5	1,042	7th row.
$2\frac{1}{2}$	$2\frac{3}{4}$	10,500	6	875	8th row.
				Gradually diminishing to less than 650 per ton.	Plate II—
$2\frac{3}{4}$	3	8,500	[a] 7–8		1st row.
3	$3\frac{1}{2}$	6,200	[a] 10		2nd row.
$3\frac{1}{2}$	4	4,000	[a] 12		3rd row.
4	....	3,200	[a] 14		4th row.

[a] At the time of making this table only a few of the larger-sized shells were available, so the estimates of blanks are less accurate.

It may be seen from the table that a marketable ton of niggerheads could be composed of the shells of 3,200 or of 33,000 mussels, according as the shells were 4 inches in length or only $1\frac{1}{2}$ inches. As a matter of fact, no marketed ton is ever composed of mussels of an exactly uniform size; furthermore, the extremely large niggerhead shells are very rare and generally not very desirable on account of inferior quality and disproportionate waste. A ton of shells from a region of depletion will also include a number of the smallest and not strictly marketable shells.

Now, let us take a concrete illustration: Several counts of mussels gathered by shellers in the White River near Clarendon, Ark., were made in October, 1913; from these an average was taken that fairly represents the catches being made at that time in that region. It was found that 60 per cent by number of the shells taken were of a size less than 2 inches in greatest dimension; also that a ton of shells comprised 20,500 pairs, of which 12,300 were less than 2 inches. Now, it is evident that if these smaller shells were returned to the bed we would be depleting the bed less than one-half as fast as at present. This would be the substantial advantage that such a size limit would have to the mussel beds; and any advantage to the mussel beds is an ultimate advantage to the fishermen, manufacturers, and all others in any way dependent upon the perpetuation of the mussels. Under the working of a 2-inch size limit, 60 shells out of every 100 then being taken on the niggerhead beds of that vicinity would have been thrown back. This seems to be asking a good deal, but not so much as at first appears, for the undersized shells constitute only 38 per cent of the weight or selling value of the shells taken.

On the other hand, both sheller and manufacturer would be saved the trouble of handling over and over again an unnecessarily large number of shells. A ton of shells (from the same locality) comprising only those above 2 inches in greatest dimension would contain about 13,000 pairs, or 37 per cent less than the number now found in a ton (20,500), while these shells, the smallest ones being eliminated, would produce at least 10 per cent more buttons of corresponding sizes.

SIZE LIMIT IN RELATION TO ECONOMY.

The figures given above are, of course, based upon counts and computations of shells from a particular locality and must not be assumed to have any general application, but the facts and principles derived do have a universal bearing. If such a size limit as 2 inches is adopted, the saving to the mussel beds and to the future of all interested parties is out of all proportion to the immediate loss to any party; and even the immediate loss is to some extent compensated by the saving resulting from having to do with a lesser number of shells that yield a greater number of buttons per ton.

Undeniably some temporary sacrifice is entailed, but unless it be admitted that temporary sacrifice will be accepted, it is useless to consider any manner of restriction for ultimate benefit.

There is one point that is brought out in the table on page 14 that merits attention from the broad standpoint of economy. In all shells there is a proportion of unavoidable waste, since the entire weight of the shell can not be transformed into buttons. In very small shells we may expect an undue waste, on account of the fact that

only one or two blanks can be cut out, leaving a larger bulk of shell in proportion to the number of blanks gained. On the other hand, in very large shells a high degree of waste is involved because of excessive thickness, which must be ground from the blanks, and because of the extra weight of the discarded portion. Somewhere between these extremes is the size of shell that yields the largest number of blanks as compared with the waste or the weight of shell that does not go into buttons. As shown by the data in the fifth column of the table, the shells a little above 2 inches in size are those (for this species) that make the best yield per ton for the small lines for which there is the greatest general demand.

REASONS FOR THE PROPOSED 2-INCH LIMIT.

Argument might be made in favor of a higher size limit as being still more favorable to the preservation of the mussels, but it is sufficient to say that the economic conditions would not justify a higher limit. At 2 inches a sufficiently severe restriction is placed upon the fishery, and to go further would be practically to prohibit the pursuit of shelling in so many localities that excessive hardship would be caused.

As consideration thus far has been given almost exclusively to the niggerhead shell, the question may well be raised, Will the same limit apply to other species of shells? The minimum size of 2 inches suggested can be taken as an absolute minimum, since there is no species of any importance for which it would be too high. This minimum would not, however, give the same degree of protection to the larger forms, such as the washboard, the bluepoint, and the mucket. Should a minimum size be fixed with particular reference to any one of these varieties, it would necessarily be a good deal higher.

In the present paper recommendation is made for this one-size limit alone, for the following reasons:

1. All conditions considered, it is the most appropriate limit that could be designated for the niggerhead mussel, which is at present the most important species of wide distribution, and which is, furthermore, the species most liable to rapid extermination. This and species closely like it, as the pigtoe, the pimple-back, and the maple-leaf, are chiefly those that are now being taken in the very small sizes.

2. The same size applies equally well to the related species just mentioned, as well as to the "hickory-nut," or "Missouri niggerhead," and the "butterfly."

3. The larger species, as the "washboard," "bluepoint," and "mucket," are generally so evidently valueless in the small sizes that shellers do not take them. At least it is not yet of observation that particular injury is being done to these species in this way.

4. To insure the least trouble of enforcement of the law, it is necessary that a minimum size be set, below which no shells of any species may be retained. There are many different species of commercial mussels, and some of them so intergrade as to make exact determination a nice matter in some cases. Distinct size limits for the different species would introduce peculiar difficulties into the practical workings of enforcement; it would be more troublesome to the sheller to observe the law voluntarily, and loopholes for evasion would more easily be found by the offender of wrong intent.

Should conditions in certain States or streams subsequently require a higher limit for particular kinds of shells, a supplemental limit may be fixed for designated species; but this could be done without affecting the application of a 2-inch limit as an absolute or universal limit below which no shells of any species could be lawfully taken. It is desirable that few different limits should ever be used, and it seems expedient to have but one size limit until the first legislation shall have been tried out.

DETAILS ESSENTIAL TO EFFECTIVE LEGISLATION.

In concluding this section emphasis may be laid on the value of certain details of legislation.

Allowable margin of undersized shells.—While it may seem desirable that no undersized shell at any time should be taken away, nevertheless it is necessary to make allowance for a margin of unintentional error. Only if the shellers and buyers were to apply an instrument of measure to each individual shell would all possibility of error be eliminated. The sheller will naturally, after a few measurements, come to judge by the eye, and it is desirable that the law should be somewhat liberal, rather than too stringent in the allowance for mistakes. There should, accordingly, be a supplemental provision that if not more than 5 per cent of the shells by number (not by weight) of any bushel are found to be below the size limit, the law shall not be presumed to be violated.

Illegal possession.—To be practicable of enforcement, the law should be so worded as to make it illegal not only to bring ashore or to offer for sale, but also to have in possession, fresh-water mussels or clams of a size less than 2 inches in greatest dimension. This one provision will obviate much unnecessary expense, as well as undesirable complications in the detection of violations and the prosecution of offenders. Furthermore, since buyers of the shells would be equally liable to prosecution, the effect would be to destroy the market for undersized shells, and thus in the most effective way to restrain the shellers from taking them.

Method of measuring mussels.—It will be noted that the method of measure is stated as "in greatest dimension," with a view to elimi-

nating every possibility of uncertainty or difference of opinion. Mussels are sometimes measured in length or width or height, but on account of the irregular form of mussel shells these dimensions are not always interpreted in the same way. In testing the blank-making capacity of a shell, commercial men sometimes measure the "width on the face"; that is, between the lateral hinge tooth and the lower margin of the shell. This measure can of course only be taken from an open shell, and therefore could not serve for our purpose. It is worth while to call attention to the fact that a 2-inch shell as measured in greatest dimension would be a good deal smaller than a 2-inch shell in commercial measurement.

An inspector would need to be equipped with an ordinary rectangular caliper. If a shell should be found to measure more than 2 inches in any linear direction it would be considered as above the size limit.

CLOSED REGIONS—NECESSITY AND APPLICATION.

In addition to the provision of size limits it is strongly recommended that certain portions of the rivers be closed for rest periods covering several years. It might be thought that in regions of extreme depletion the operation of a size limit would, by making the fishery less profitable, have the effect of causing a practical rest period, but this can not be expected, for, stimulated by the high price of shells and the ever-present hope of making a pearl find, the local shellers will hardly ever desist entirely from the fishery.

No better way of giving protection to mussels can be found than that of entirely stopping the shelling upon a series of beds, although the plan must be applied in such a way as not to reduce the supply of mussels unduly and suddenly and with as careful regard as possible to the established interest of communities.

INJURY TO SPAWNING MUSSELS AND TO YOUNG.

Some of the conditions that make a system of closed regions particularly advisable for the conservation of fresh-water mussels may be briefly mentioned:

1. It has been previously stated that some of the mussels are spawning, or with spawn, during any period of the year. Many of the most important species are spawning during the late spring, early and mid summer; other equally important species form their eggs in the late summer, when they become fertilized and develop into the glochidium stage, but the mother clam retains them in marsupial pouches within her shell during the entire winter and even into the summer. All species of mussels carry the eggs in the marsupial pouches during the process of development to the glochidium stage

or longer, whether the period be for a few weeks or for a few months. In this condition the mussels are said to be gravid. It is readily observed that when gravid mussels are disturbed they frequently discharge the young, regardless of whether these are mature enough to be liberated from the parent or not; certain species, such as the niggerhead, are particularly likely to do this.

In the commercial fishery, therefore, not only is much spawn destroyed when large gravid mussels are captured, but it is quite probable that other mussels, disturbed on the bottom, though not captured, are caused to abort the young in an immature stage when they are entirely unable to complete the development without the parent.

2. In the stage of existence immediately after liberation from the parent, the young mussels are parasitic upon fish. We are not here concerned with them during this period of the life history. When they are dropped from the fish many of the young mussels do not at once take up life in the sand or mud of the bottom, but we find them forming delicate threads by which they hang from plants or sticks or stones or from clam shells, and thus are kept from being washed away or smothered in the mud of the bottom. We may imagine the harm to these little mussels that is unavoidably wrought when the beds are continually dragged over. In like manner, the little shells that are just beginning to take hold in the bottom may be torn out by the rake or hooks, to be smothered or washed away to less favorable bottoms. It will be remembered that when mussels first begin life in the thread stage or in the bottom if the thread stage is omitted, they are too small to be found without a microscope.

3. One of the principal methods of capturing mussels is with the bar and hooks dragged over a large area of mussel bed in taking a relatively small number of shells. There is chance for these hooks to injure many little shells when each drag, requiring a period of only a few minutes, covers a space of bottom 16 feet wide and several hundred feet long. Nevertheless, it is not certain that there is any method to take its place, and any implement used will accomplish some injury to the very youngest mussels.

CONSIDERATIONS DETERMINING SIZE OF CLOSED REGIONS.

In planning for the closing of portions of rivers for periods of years consideration should be given to community needs as well as to general economic and biological conditions. On the one hand, the closure will be more effective in result, as well as easier of enforcement, if the regions of closure are made very large; while, on the other hand, making the closed regions smaller might cause less economic inconvenience. If, for example, the entire Illinois River should be closed to mussel fishery for a period of several years, there

might be a substantial uncompensated loss to some communities, where there are factories employing labor to cut shells derived from that river. On the other hand, should we divide the river up into small sections of 2 or 3 miles in extent, some of which would be open while others would be closed under the law, it is apparent that such a plan would be almost impossible of enforcement. To prevent shelling from being carried on in all these little closed areas would require a force of wardens and an expense entirely incommensurate with the object to be gained.

It is held advisable to divide a river within a single State into some four or six sections for the purpose of establishing closed regions. One-half—that is, two or three—of these sections, taken in alternation, could be ordered closed for a period of five years, during which no mussel fishing at all should be allowed in the closed sections, although it would be regularly prosecuted in the alternate portions of the stream. It would be convenient to break a river at points where there was a substantial community interest in the shelling.

PRACTICABLE DIVISION OF RIVER SYSTEMS ILLUSTRATED.

For example, let us apply this method of dividing a stream to the White and Black Rivers in Arkansas. Starting from the headwaters of the Black River, we find the first center of economic interest at Black Rock, another on the White River at Newport, and a third at Clarendon. Now, the river might properly be broken at these points, forming four main sections. The fishery might then be entirely prohibited for several years from the mouth of the river to Clarendon, while permitted from Clarendon to Newport, and again prohibited from Newport northward to Black Rock on the Black River, and to Batesville or other suitable point on the upper White, while permitted from Black Rock and Batesville northward on all the tributaries. We would have the river system divided into four sections, which would be probably as nearly equivalent as could be expected. Furthermore, none of the three towns mentioned would be cut off from the local supply of shells, except in one direction.

The shellers, generally speaking, would be little affected, since, with their house boats, they could move from one portion of the river to another. Those shellers who do not use house boats, but are local residents and go out only by day from their homes, would be most affected, and it is these generally who are most in favor of closing portions of a river. They recall how much more easily shells were taken in past times when the shells were abundant, and they would be willing to do something else meantime in order that the beds may be given a rest and the shells again become numerous. Shelling has no attraction over any other form of crude labor when the shells are so scarce that a wage can scarcely be made.

Taking the St. Francis River in Arkansas as another illustration, the river might be broken at Madison, Parkin, and Marked Tree. It is true that there are not many mussels, according to report, above Marked Tree, but the region between Madison and Parkin has beds which may well balance the remainder of the river.

The Wabash River, Ind., is one in which the need for protection is most evident; and this stream could be divided at Vincennes and two other points selected with reference to their economic interest in shelling and with regard to an equitable division of the river system.

It might seem that an ideal method of rotation would be based upon the division of a system into six portions, only one of which should be worked in any one year; a new portion would be opened each year, while each territory would enjoy a rest period of five years between successive "open" years for that particular territory. It will be evident that such a scheme, however correct in theory, would be entirely impracticable. The plan of keeping certain regions closed for periods of years while other regions are worked continuously during a corresponding period of years may have some imperfections, but it is probably the best that can be worked out without practically suspending the industry. Undoubtedly the plan will work most efficiently if a proper discretion is used in its application.

PROCEDURE FOR ESTABLISHING CLOSED REGIONS.

The law should plainly stipulate and establish the principle of the closure of the rivers by regions or sections, but the determination of which specific sections are to be closed should be left for determination after investigation by properly qualified authorities.

A comparatively simple plan may be suggested under which the most careful consideration could be given to the local conditions involved as well as to the rights of the State as a whole. The legislature could authorize and instruct the proper State authorities, as the State fish commission, to give due consideration and study to the needs of the mussel industry and determine what portions of the streams of the State should be closed to the mussel fishery for a period of years. It could be further provided that, after the preliminary determination of plans for closure, due advertisement should be made in all regions affected and opportunity given for public hearings in such regions, after which the commission should submit its final recommendations to the governor of the State, who should then issue a proclamation ordering the entire interruption of a mussel fishery in the regions selected for closure. The original legislative act should provide that the proclamation so made should have the full effect of law, and should specify the penalties that

would be incurred by violations. It is desirable also that the governor, upon recommendation of the commission, should have power to reopen the closed regions when such action was judged necessary.

ENFORCEMENT OF THE LAW.

Powers of officers.—It is necessary not only that the duty of enforcement of the law be assigned to specified State officers, but also that they be expressly given the right to inspect and examine mussels or shells in the boats or on land and be empowered to seize mussels or shells held in violation of the law. It is practically impossible to bring about convictions when the opportunity is allowed for destruction of the evidence between the time of detection and the date of trial.

Permits for special cases.—In cases where for the purposes of investigations it may be necessary to take small mussels, the State officers charged with the enforcement of the law should have by law the right to issue special permits for the taking of undersized mussels for scientific uses and not for sale.

Expenses of mussel protection.—The plans which have been advanced in this report can be carried out with a minimum of expense. The simplicity of the measures would reduce the trouble and cost of inspection to the smallest practicable figure. The assignment of the duties of enforcement to existing State commissions or boards which already have field deputies or wardens obviates the creation of any special offices for execution of the mussel laws.

The question of whether steps should be taken to raise special funds on account of the additional burdens that would be placed upon the present boards is one that would be determined by each State in the light of its own conditions and established customs. It would be very undesirable to create a burdensome tax; to do so would only react against the State, and in the end the tax would be paid by the shellers, who are now making only a meager living, for the local shellers would have to sell in competition with the shellers from States where more liberal conditions prevail.

It is another matter, however, to require a nominal license fee for the privilege of working upon the public mussel beds. Such a fee need not be greater than $1 or $2 per season, an amount which could be paid by anyone who wished to shell seriously. Perhaps the idea of a fee of any kind would arouse some antagonism among a certain class of shellers who would enjoy the public stores without return of any kind. Some shellers favor such a license system, and the writer believes that they must all eventually come to see that it works to their own particular advantage in many ways. It tends to create a class of professional shellers, besides providing the necessary means for promoting the abundance of shells.

SUMMARY OF RECOMMENDED LEGISLATION.

The legislation recommended for protection of mussel beds, based upon the considerations discussed in the preceding pages, may be summarized as follows:

I. (*a*) A single size limit should be fixed as applicable to all shells taken. The minimum size here proposed is 2 inches.

(*b*) The method of measuring the shell should be defined as "in greatest dimension."

(*c*) Possession of undersized shells, whether or not sold or offered for sale, should be illegal.

(*d*) There should be an allowable margin of undersized shells for unintentional violation.

II. (*a*) Alternate portions of rivers or river systems should be closed for a period of years, to permit recuperation of mussel beds.

(*b*) The units of division of a river system should be large enough to make enforcement practicable with least expense.

(*c*) The river would conveniently be broken at the few points where there is most community interest involved in the shelling.

(*d*) Approximately five-year periods of closure are recommended, with some discretion allowed to executive officers as to duration of period.

(*e*) Closed regions should be established by proclamation of the governor of the State, after expert examination of the mussel beds and after public hearings on the subject in the communities affected.

III. (*a*) Officers charged with enforcement of the law should be empowered to examine mussels or shells in boats or on land and to seize the catch in case of violation, as well as to arrest or cause arrests to be made.

(*b*) Provision should be made for the issue of permits for the taking of mussels of any size or in any region for scientific uses and not for sale.

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